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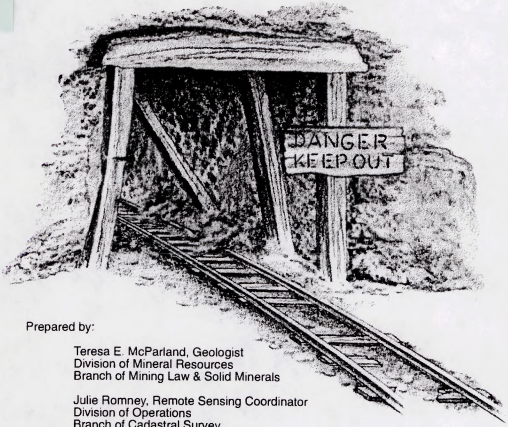
UTAH'S ABANDONED MINE LAND INVENTORY

Pilot Project Report



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December 1995

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I. Executive Summary

BLM Utah began development of an abandoned mine land (AML) inventory methodology in the fall of 1991. The AML inventory was based on budget directives for fiscal year 1992 which stated, "The Office of Management and Budget is requiring Bureau of Land Management (BLM) to submit a report identifying major potential hazardous materials sites on public land by September 30, 1993" and "Additional mines (active and inactive) having lower potential risks will be inventoried until all are completed in fiscal year 1997." Utah's strategy was put in writing on July 21, 1992.

Utah's modified methodology consisted of the following steps: (1) compile existing information, (2) identify which information is usable, (3) develop a site inventory checklist, (4) identify sites using remote sensing techniques including satellite imagery, airborne videography and aerial photography within a pilot project area, (5) verify identified site locations using GPS as an inventory tool within the pilot project area, (6) complete a statistical analysis between remote sensing and field verification, (7) prepare a HAZMAT report of major potential sites within the pilot project area, (8) develop a Statewide inventory methodology based on pilot project results, and (9) implement a Statewide abandoned mine material site inventory. A pilot project was chosen in southeast Utah, within the BLM San Juan Resource Area, and is composed of the Cottonwood Wash mining district. This district is 23 square miles in size.

Remote sensing techniques identified a total of 224 potential sites. Of these, the ground verification identified 61 as mine sites. Comparatively, the existing Mineral Industry Locations System (MILS) and Utah Mineral Occurrence System (UMOS) data bases listed 40 sites and 27 sites, respectively. Based on these results, we recommend the use of aerial photography for field site location. Additional criteria must be developed to make mine site identification from aerial photography more accurate. The recommended scales of photography include a range of 1:15,000 to 1:40,000. The remote-sensing data that require evaluation for its role in future site identification and field work are digital orthophotos (photographic image rectified to a map base, stored on a computer). In the summer of 1996, we will evaluate the utility of Landsat and SPOT satellite imagery in conjunction with ground spectrometry.

We do not recommend the correlation of the AML inventory effort with UMOS or MILS. These data bases were created as resource-occurrence and location-of-mines data, respectively. Consequently, they do not aid in locating all abandoned mine land features (e.g. every shaft, adit, waste dump, etc.). Also, these data bases do not meet our inventory needs because the information required to rank a site as to its physical safety hazards, environmental hazards and reclamation problems is not available. The UMOS and MILS data bases are excellent sources of background information and for reducing the area to be inventoried intensively on the ground.

The Global Positioning System (GPS) medium-precision units proved to be an invaluable resource inventory tool. This equipment not only provides georeferenced coordinates, but allows this information to be described (attributed). The data base structure is set by the BLM Abandoned/Inactive Mine Land Inventory Field Checklist[1]. Each time the checklist is changed, the data base structure is altered. Finalizing the checklist is a top priority for the AML inventory effort. A ranking program is a key factor to aid in finalizing the BLM Abandoned/Inactive Mine Land Inventory Field Checklist.

The AML pilot strategy of using ArcCAD[2] is not recommended for individual BLM State inventories. The required computer skills, training issues, the difficulty in accessing base and resource data themes in Map Overlay and Statistic System (MOSS) format on mainframe platforms, and software and hardware limitations make the PC-based ArcCAD strategy unacceptable.

The field-collected GPS data should be differentially corrected and then exported and downloaded into comma-delimited ASCII files. This will allow the AML data to be used during the interim of obtaining the target GIS system in each State. The individuals collecting the data should use the resources available to them to verify that the feature and attribute data are correct, (e.g., feature data could be corrected using MOSS, Arc/Info, or ArcView whereas the attribute data could be corrected using dBase IV, INFORMIX, or Info). The differential correction of the georeferenced coordinates, and verification of feature data and attribute information should be completed as soon as possible after the data is collected.

The list of attributes used to characterize potential hazards and priority for reclamation should be minimized. AML State Coordinators should consult with GIS specialists to determine which attributes may be effectively determined in-house using GIS analysis tools on existing data bases.

Our experience through the pilot effort shows that GPS technology can be used to expedite and provide a cost effective method to complete the inventory. Remote sensing techniques utilized require the development of additional criteria to identify

---

[1] This is the current AML inventory checklist that is dated March 1995. The checklist used for the collection of 1993 data was entitled Abandoned Mined Lands Field Inventory Data Sheet. The 1994 data was collected using an earlier version of the Abandoned/Inactive Mine Land Inventory Field Checklist.

[2]The use of trade names throughout this report is for information only and should not be viewed as a product endorsement.

AML sites accurately before they will be an effective inventory tool. GPS-collected data should be differentially corrected and converted to a maintainable file format.

II. Introduction

BLM Utah began development of an abandoned mine land (AML) inventory methodology in the fall of 1991. The impetus for the development of an inventory strategy was the budget directives for fiscal year 1992. The directives for mining law stated, "The Office of Management and Budget is requiring BLM to submit a report identifying major potential hazardous material sites on public land by September 30, 1993." Under the general directives, additional mining law and non-energy leasable guidance stated, "Additional mines (active and inactive) having lower potential risks will be inventoried until all are completed in fiscal year 1997." Utah's strategy was put in writing on July 21, 1992. This inventory strategy was a collaborative effort of the BLM Utah State Office's Cadastral Survey, Mapping Sciences, HAZMAT and Mineral Resources. We have since modified this strategy due to our field experience and increased knowledge of how the inventory factors must interrelate.

Utah's modified methodology consists of the following steps: (1) compile existing information, (2) identify which information is usable, (3) develop a site inventory checklist, (4) identify sites using remote sensing techniques within a pilot project area, (5) verify identified sites using GPS as an inventory tool within the pilot project area, (6) complete an analysis between remote sensing and field verification, (7) prepare a HAZMAT report of major potential sites within the pilot project area, (8) develop a Statewide inventory methodology based on pilot project results, and (9) implement a Statewide abandoned mine material site inventory.

A key factor in Utah's strategy was to conduct a pilot study to utilize several different technologies to determine which techniques worked the best to identify as many sites as possible economically. This report will summarize our methodologies and findings regarding field protocol, data base development, and ranking program development.

Initially the pilot project area was identified as four mining districts in southeast Utah within the San Juan Resource Area. Figures 1 and 2 show the general and detailed pilot project areas. These mining districts, their corresponding size and priority for inventorying were as follows: (1) Cottonwood Wash, 23 square miles; (2) White Canyon, 101 square miles; (3) Fry Canyon, 43 square miles; (4) Red Canyon, 107 square miles. We anticipated assistance of BLM Resource Area and District Geologists and HAZMAT Coordinators throughout the State. Unfortunately, their schedules did not allow them to participate in the collection of data in the field. This meant there were only two and eventually three people to complete the pilot project. In addition, the field work was reduced by a month due to unforeseen external circumstances. Therefore, the pilot project area was reduced to the first priority to be inventoried—Cottonwood Wash mining district.

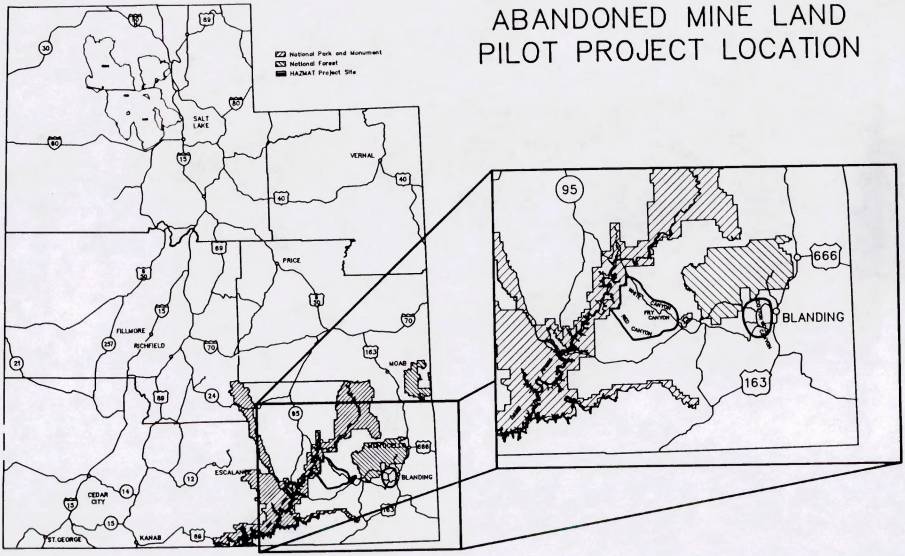
ABANDONED MINE LAND
PILOT PROJECT LOCATION
National Park and Monument
National Forest
HAZMAT Project Site
SALT LAKE
VERNAL
PRICE
FILLMORE
RICHFIELD
MOAB
ESCALANTE
BLANDING
CEDAR CITY
ST.GEORGE
KANAB
95
666
163
BLANDING

Figure 1

UTAH ABANDONED MINE LAND PILOT PROJECT LOCATION

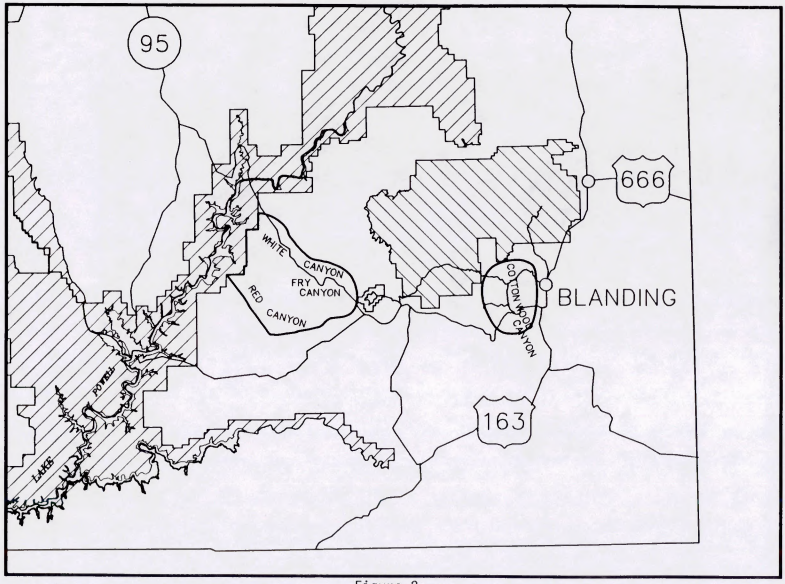

Figure 2

The majority of the ground verification of the Cottonwood Wash mining district was completed during the 1993 field season. The remaining portion of this district was completed in one field session of 8 days, and the White Canyon mining district ground inventory was begun in the second session of the 1994 field season. Due to unforeseen difficulties (vehicle problems), the size of the district, and reduced number of individuals for field collection, the inventory for this district was not completed during the 1994 field season. The White, Red, and Fry Canyon mining districts were completed during the 1995 field season. Since the analysis of the White, Red, and Fry Canyon mining districts data was not completed when the report was written, this report will address the findings of the Cottonwood mining district only.

The Cottonwood mining district includes five 7.5-minute quadrangles. These quadrangles are: Black Mesa, Hotel Rock, Blanding North, Mancos Jim Butte and Blanding South.

III. Initial Site Identification

A. Remote Sensing's Role as an AML Inventory Tool

1. Remote Sensing Methodology

Given the magnitude of an AML inventory, it was desirable to identify as many mine sites as possible through remote sensing multispectral analysis and aerial photo interpretation technologies. Three remote sensing techniques were utilized in the pilot project area in order to evaluate their effectiveness in identifying abandoned mine sites. Each of the three techniques were evaluated as a "stand-alone" method and how they complement each other in a "multi-tiered" process (e.g., Satellite Pour l'Observator de la Terre (SPOT) satellite imagery may be best at identifying large areas to focus on, whereas aerial photography or videography may be used to extract the highest amount of detail possible from these targeted areas). The flow chart shown in Figure 3 details the specific processes involved with each individual methodology, as well as how the three separate techniques were joined into a single data base for field verification.

a. Airborne Videography

Multispectral videography of the study area was acquired through Utah State University. Two levels were flown: 2½-meter resolution video was flown at an altitude of 8,000 feet. Flightlines were spaced every 30 seconds (latitude/longitude coordinate system) apart in an east-west pattern across the entire area. A 1-meter resolution video, flown at approximately 3,500 feet above the ground, was acquired of selected areas of known mining activity.

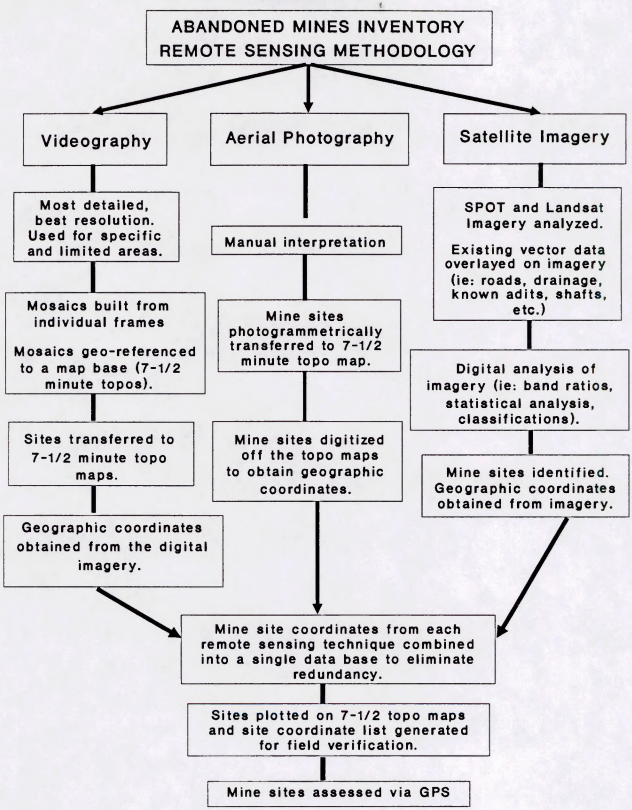
ABANDONED MINES INVENTORY
REMOTE SENSING METHODOLOGY
Videography
Aerial Photography
Satellite Imagery
Most detailed, best resolution. Used for specific and limited areas.
Mosaics built from individual frames
Mosaics geo-referenced to a map base (7-1/2 minute topos).
Sites transferred to 7-1/2 minute topo maps.
Geographic coordinates obtained from the digital imagery.
Manual interpretation
Mine sites photogrammetrically transferred to 7-1/2 minute topo map.
Mine sites digitized off the topo maps to obtain geographic coordinates.
SPOT and Landsat Imagery analyzed.
Existing vector data overlayed on imagery (ie: roads, drainage, known adits, shafts, etc.)
Digital analysis of imagery (ie: band ratios, statistical analysis, classifications).
Mine sites identified. Geographic coordinates obtained from imagery.
Mine site coordinates from each remote sensing technique combined into a single data base to eliminate redundancy.
Sites plotted on 7-1/2 topo maps and site coordinate list generated for field verification.
Mine sites assessed via GPS

Figure 3

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Utah State Office
P.O. Box 45155
Salt Lake City, Utah 84145-0155

IN REPLY REFER TO:
3809
(UT-931)

October 3, 1997

Daniel V. Ziarkowski
California Environmental Protection Agency
Department of Toxic Substances Control
Region 1 Site Mitigation Branch
10151 Croydon Way, Suite 3
Sacramento, CA 95827-2106

Dear Mr. Ziarkowski:

Enclosed is the information you requested. The report entitled "Utah's Abandoned Mine Land Inventory Pilot Project Report" documents Utah Bureau of Land Management's (BLMs) process. However, the data base development section of this report is out of date. The major change since December of 1995 is that the georeferenced coordinates and associated attributes are exported as shape files and brought directly into ArcView. This allows the data to be used and analyzed immediately.

We would strongly recommend the use of Global Positioning System (GPS) equipment with attributing capabilities in your inventory effort. Our reasons for choosing GPS as an inventory tool were threefold. The three reasons were: (1)the collection of georeferenced coordinates would allow staff to navigate to a site for additional studies; (2)the Abandoned Mined Land (AML) Field Inventory Checklist could be collected digitally; and (3) the georeferenced coordinates would allow the site to be located correctly on a topographic map. For more information, please see page 16 of the pilot project report.

Another advantage to using GPS technology for an AML inventory is as soon as the data is differentially corrected it can be used in a Geographic Information System. Existing layers of data, e.g., geology, water courses, roads, population centers, groundwater data (if available), etc. can be used to analyze the inventoried AML sites. This will assist in prioritizing remediation efforts.

A very important lesson we have learned is to define data base needs as soon as possible. Every time a change is made as to what is collected at a site the entire data base structure is modified. Also, we would recommend that the data base size be smaller than our existing data base. The inventory is to determine how many sites and what problems exist at each site. A detailed

assessment of a site is not necessary until the point in time that the site will be remediated. We will use the National Environmental Policy Act to determine the best closure method at a site. The latest version of our Abandoned Mine Land Inventory Field Checklist and datalogger directions are enclosed for your information.

Experience has shown that the number of AML sites is larger than existing information indicates. However, the majority of the problems exiting at AML sites are safety hazards rather than environmental hazards.

The enclosed bat policy is the protocol used by the State of Utah Division of Oil, Gas and Mining, Abandoned Mine Reclamation Program. The policy allows a biologist to safely enter abandoned underground workings. It has never been formally approved; however, it is used as a guide for conducting internal surveys. If you would like additional information regarding their policy, please call Mark Mesch, Abandoned Mine Reclamation Program Administrator. His telephone number is (801) 538-5349.

In addition, you had requested information concerning reclamation of abandoned mine sites. To assist in this endeavor we have enclosed the BLM Solid Minerals Reclamation Handbook H-3042-1. The purpose of this manual was to provide consistent reclamation policy and guidelines for all noncoal solid mineral activities permitted, leased, accepted or approved by the BLM. We will use this as a resource when we get to the point that we are closing abandoned mine sites.

Another aspect of the AML program briefly touched on in your conversation with Terry McParland of my staff is the Site Safety and Health Plan for the AML Inventory field work. Associated with this plan is appropriate training. The training we provide for field inventory personnel includes the following topics: first aid with an emphasis on potential field situations (a final examination simulates a real injury in which the knowledge gained from the class is used), Chemical Management/Hazardous Material Recognition/Safety with an emphasis on mining activity, radiation and abandoned mine safety, tread lightly vehicle policy, minimum-impact camping techniques, cultural resource awareness, reviewing the BLM Abandoned/Inactive Mine Land Inventory Form, mine terminology, and use of GPS equipment. We emphasize the BLM's policy of no entry for the AML inventory and the importance of collecting the checklist data in a safe manner. An additional safety precaution, which we employ in our inventory effort, is to work in teams of two.

If we have not fully addressed all your concerns or if you have any additional questions, please call Terry McParland at (801) 539-4026 or E-mail her at tmcparla@ut.blm.gov.

Sincerely,

/s/ Douglas M. Koza

Douglas M. Koza
Deputy State Director
Natural Resources

Attachments:
Utah's Abandoned Mine Land Inventory Pilot Project Report
Abandoned Mines Brochure
Utah's Abandoned Mines Stay Out and Stay Alive Video
Bureau of Land Management Abandoned/Inactive Mine Land Inventory Field Checklist with radiation section
Bureau of Land Management Abandoned/Inactive Mine Land Inventory Field Checklist without the radiation section
Bureau of Land Management Abandoned/Inactive Mine Land Inventory Field Checklist Directions for Datalogger
Bureau of Land Management Abandoned/Inactive Mine land Inventory Field Checklist Directions for pencil copies of the form
Bureau of Land Management Abandoned/Inactive Mine Land Inventory Field Checklist Directions Attachments
State of Utah's Site Form
State of Utah's Shaft Field Description Form
Waste Dump Field Description Form
Adit or Tunnel Field Description Form
Guidelines and Instructions for State of Utah AMR Site Form and Feature Attachments
State of Utah's Bat Survey Policy
Site Safety and Health Plan for the Abandoned Mine Land Inventory
BLM Manual 3042 Land Reclamation
BLM Solid Minerals Reclamation Handbook H-3042-1

cc: Mark Mesch, Division of Oil, Gas and Mining, Abandoned Mine Land Reclamation Program Administrator (w/o attachments)

bcc: Jinx Fox, WO-360 (w/o attachments)
Barb Campbell, BLM Library Denver (w/ attachments)

bcc: Solid Files
Chron Files
McParland

McParland:mc: 10/01/97
CAMEMO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Utah State Office
P.O. Box 45155
Salt Lake City, Utah 84145-0155

IN REPLY REFER TO:
3809
(UT-931)

October 3, 1997

United States Army Environmental Center
Attention SFIM-AEC-EQN (Pam Klinger)
Aberdeen Proving Ground, MD 21010-5401

Dear Ms. Klinger:

Enclosed is the information you requested. The report entitled, "Utah's Abandoned Mine Land Inventory Pilot Project Report" documents Utah Bureau of Land Management's (BLMs) process. However, the data base development has changed significantly since December of 1995. The major change is that the georeferenced coordinates and associated attributes are exported as shape files and brought directly into ArcView. This allows the data to be used and analyzed immediately.

We would strongly recommend the use of Global Positioning System (GPS) equipment with attributing capabilities in your inventory effort. Our reasons for choosing GPS as an inventory tool were threefold. The three reasons were: (1) the collection of georeferenced coordinates would allow staff to navigate to a site for additional studies; (2) the Abandoned Mined Land (AML) Field Inventory Checklist could be collected digitally; and (3) the georeferenced coordinates would allow the site to be located correctly on a topographic map. For more information, please see page 16 of the pilot project report.

A very important lesson we have learned is to define data base needs as soon as possible. Every time a change is made as to what is collected at a site the entire data base structure is modified. The latest version of our Abandoned Mine Land Inventory Field Checklist and datalogger directions are enclosed for your information.

The enclosed bat policy is the protocol used by the State of Utah Division of Oil, Gas, and Mining, Abandoned Mine Reclamation Program. The policy allows a biologist to safely enter abandoned underground workings. It has never been formally approved; however, it is used as a guide for conducting internal surveys. If you would like additional information regarding their policy, please call Mark Mesch, Abandoned Mine Reclamation Program Administrator. His telephone number is (801) 538-5349.

In addition, you had requested information concerning reclamation of abandoned mine sites. To assist in this endeavor we have enclosed the BLM Solid Minerals Reclamation Handbook H-3042-1. The purpose of this manual was to provide consistent reclamation policy and guidelines for all noncoal solid mineral activities permitted, leased, accepted or approved by the BLM. We will use this as a resource when we get to the point that we are closing abandoned mine sites.

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If we have not fully addressed all your concerns or if you have any additional questions, please call Terry McParland at (801) 539-4026 or E-mail her at tmcparla@ut.blm.gov.

Sincerely,

Douglas M. Koza

Douglas M. Koza
Deputy State Director
Natural Resources

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State of Utah's Bat Survey Policy
Site Safety and Health Plan for the Abandoned Mine Land Inventory
BLM Manual 3042 Land Reclamation
BLM Solid Minerals Reclamation Handbook H-3042-1

cc: Mark Mesch, Division of Oil, Gas and Mining,
Abandoned Mine Land Reclamation Program Administrator (w/o attachments)

The following is a description of the airborne multispectral video/radiometer remote sensing system developed by Utah State University. The system consists of three video cameras. These cameras are COHU 4810 series, monochrome, high resolution (525 horizontal lines) solid-state CCD. The video cameras are filtered with 10-micrometer-wide interference filters centered in the green (0.55 micrometers), red (0.65 micrometers) and near-infrared (0.85 micrometers) portion of the electromagnetic spectrum. The spectral imagery is recorded by three Panasonic AG-7400 portable S-VHS video tape recorders. The S-VHS format has approximately 425 horizontal TV lines of resolution. All cameras are genlocked in sync, with the green band camera selected as the master. The master camera sync signal is supplied to a SMPTE time code generator (TCG). During data-collection flights, the time code is encoded on the audio channel #2 of each spectral band tape. In this way, the synced video frames have the same SMPTE time code address on each tape. The TCG allows the placement of a window on the video tape for visual inspection of the time code. A Trimble Pathfinder GPS is utilized for the geolocation of the video scenes. During data-collection flights, the system is set to sample a latitude/longitude position once every second. The GPS system provides an approximate location for the video scenes since there is no correction presently being made for the pitch, roll, and yaw of the aircraft. In addition, the latitude/longitude locations obtained with the GPS system had accuracies that were restricted to between 20 and 100 meters, depending on the introduced noise and other considerations. The cameras are aligned to view the same scene on the ground surface according to the planned flight altitude above ground (Neale, 1991).

Once the videography was collected and assessed, it was determined that a visual inventory would be initially conducted in order to provide data to field personnel in as timely a manner as possible. Only after field data is received from ground verifying the visual inventory sites, will a supervised classification be conducted on the multispectral video.

It was determined that the green band was the most effective at visually identifying mine sites and disturbed areas. The undisturbed areas on the green and red bands appeared to have similar individual file reflectance values. However, in the disturbed areas, although all values increased, the green band was substantially higher. Therefore, the green band was used to construct the visual inventory base data. The working keys for identifying mine sites were: tone, contrast, pattern, shape, proximity to access roads, and relationship to landforms. A total of 165 digital image mosaics were created for the entire pilot project area, completing the visual inventory.

The video frame grabbing configuration for single-band data consisted of the Map and Image Processing System (MIPS v3.3 and v3.4) software and Truevision TARGA + 64 video capture and display board. Video format was S-VHS tape run on a Panasonic S-VHS AG-1960 Hi-Fi Video Cassette Recorder.

The spectral video images are digitized with a TARGA+ 16/32 frame grabbing and display board installed on a PC 386 computer and configured to digitize at 8 bits, 512 X 482 pixels. A Panasonic AG-7400 S-VHS video editor is used to play back the videotapes. Both the video editor and the frame grabbing board are controlled by a DIAQUEST board and the software installed on the PC 386 computer. The DIAQUEST board can read the SMPTE time code on the audio channel #2 of each tape and digitize the desired video frame, or sequence of frames, by controlling the TARGA+ board and the video editor automatically.

For multispectral video processing, individual video frames must be stretched in the "X" direction by approximately 30-percent before being stitched. Stretching is done through ERDAS software and is based on the Nearest Neighbor Resampling scheme. This resizes the video to an image size of 642 X 482 pixels.

Video scenes were originally planned to be rectified (georeferenced to the UTM projection) and sites identified and coordinates gathered from the imagery. The first mosaic was georeferenced with 18 control points (UTM coordinates were obtained from locating and digitizing points off of orthophoto quads) and a Root Mean Square (RMS) of 1. It was determined that the processing was too time-consuming to complete georeferencing on all 165 video mosaics of the study area and have the preliminary inventory data available in time for the field season schedule. Therefore, for the initial inventory, an optical transfer method of sites from video imagery to aerial photography was developed. This proved to be a more efficient solution to the inventory because it used the same final source base with the aerial photo manual interpretation phase, as during photogrammetric transfer.

The following summarizes the general steps used in the single-band visual inventory:

* Video segments desirable for capture were identified (visual editing was done to eliminate portions of the study area where no mining activity had occurred).

* Individual frames were captured in MIPS with a 30-percent overlap to facilitate mosaicking.

* Mosaics were created from individual image strings.

* Mosaic boundaries were delineated on orthophoto quadrangles through visual identification and GPS locations encoded on the video frames.

* Mosaics were reformatted to ERDAS files, enhanced, and interpreted.

* Aerial photos were accessed for the area and disturbed sites were optically transferred from video to aerial photos using a blue pencil.

* Sites on aerial photos were photogrammetrically transferred to 7.5 minute, 1:24,000, USGS topographic quadrangles.

* Sites were field-checked to determine if disturbed areas were due to mining activity.

b. Aerial Photography/Photogrammetry/Base Maps

The aerial photography covering the area was manually interpreted using a standard 2-4x powered desktop stereoscope. Sites identified on the photos were outlined in red pencil. These sites were transferred photogrammetrically to 7.5 minute topographic quadrangle maps. The same set of quadrangle maps were used for source data from aerial photos and videography in order to eliminate redundancy in the data base. Because two sources of data were being plotted on base maps, the following color-coding system was used. Sites identified on both photos and video were plotted in red on the base maps. Sites identified via videography only were plotted in blue. Figure 4 is an example of the product that was utilized in the field.

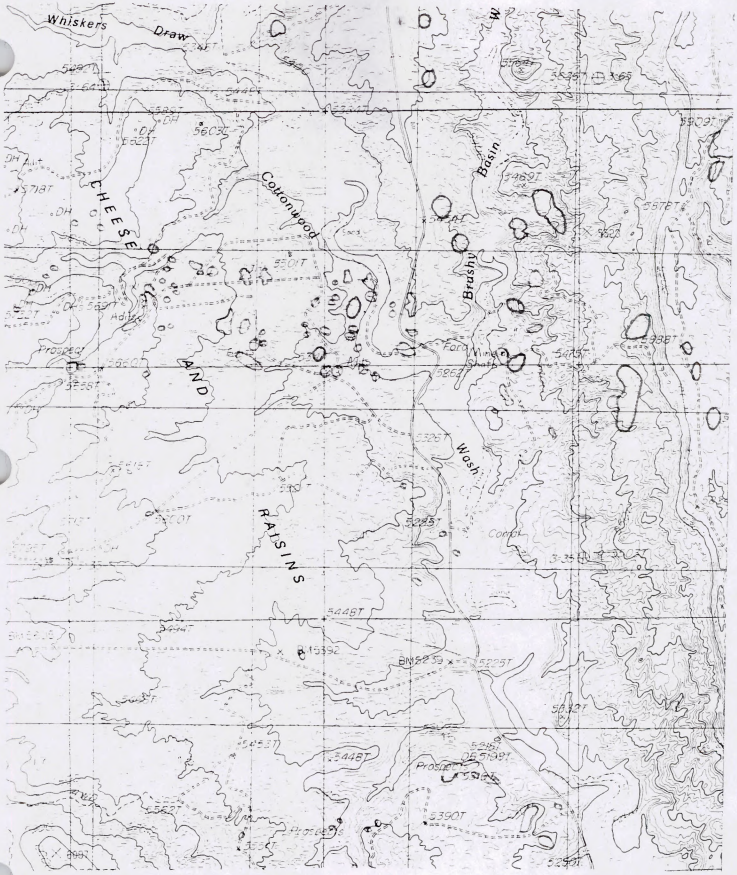
Once the sites were plotted on the maps, the quads were divided into quadrants and each quadrant enlarged to show adequate detail per site. The actual sites were then inspected. Navigation was accomplished through the assistance of topographic quads, aerial photos, and GPS. Areas that were indeed mine sites were assigned an identification number and shaded on the map. Field data was collected on these sites. Areas that were not sites remained as an outline on the map, with no identification number or geographic coordinates. Figure 5 illustrates a sample base map that has been field-verified using this strategy.

c. Satellite Imagery

Both SPOT and Landsat TM imagery are being used in the inventory and have been clipped to correspond to the pilot project area. The imagery was acquired in 1989. The SPOT and Landsat images are being analyzed separately as well as in a combined image file. This will allow an assessment of how well the images complement each other. Further analysis (e.g., supervised classification) will be conducted with the field site data results, once ground spectrometry data is available. The ground spectrometer equipment was expected to be available for the 1995 field season; however, the equipment did not arrived.

Figure 6 illustrates the entire remote sensing process for the AML pilot project.

Sites Identified via Aerial Photography and Videography



Sites identified on both aerial photos and videography

Sites identified via videography only

Figure 4

Whiskers
Draw
CHEESE
AND
RAISINS
Cottonwood
Basin
Brushy
Wash
Ford Windmill
Shaft
Corral
Prospect
Prospect
Prospect
Adit
Dis 5897T
5960T
5823T
5897T
5901T
5660T
5320T
5285T
5448T
5225T
5390T
5897T
5936T
5897T
5928T
5897T
5901T
5897T
5936T
5897T
5928T
5897T
5901T
5897T
5936T
5897T
5928T
5897T
5901

Figure 6

PROJECT TIME TABLE

SPOT IMAGERY	Obtain Imagery			Preprocessing								
LANDSAT TM IMAGERY				Obtain Imagery & Preprocessing								
VIDEOGRAPHY	Obtain Imagery			Single-band Processing				Sites Identified & Transferred to Photos				
AERIAL PHOTOGRAPHY/PHOTOGRAMMETRY				Obtain Photos			Manual Interpretation		Photogrammetric Transfer to Topo Maps			
SPECTROMETRY												
SCANNING AP					Photos Identified for Scanning			Photos Scanned and Digital Images Created				
	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG
			1992				1993					

PROJECT TIME TABLE cont.

SPOT IMAGERY			Supervised Classification & Analysis (w/Spectrometer Data		
LANDSAT TM IMAGERY			Supervised Classification & Analysis		
VIDEOGRAPHY		Creation of MS Mosaics	Multispectral Mosaic Processing/ Classification & Analysis		
AERIAL PHOTOGRAPHY/PHOTOGRAMMETRY					
SPECTROMETRY		Obtain Spectrometer	Field Data Gathered & Applied To Imagery		
SCANNING AP		Correlation of Photos to Spectrometry Data			
	SEPT	OCT	NOV	DEC	
			1993		1994/1996

B. Additional Sources of Information for Initial AML Site Identification

In addition to the remote sensing techniques utilized (aerial photography, satellite imagery and videography), the following items were used to narrow the area to be inventoried on the ground:

1. U.S. Geological Survey (USGS) Topographic Maps--7.5-minute coverage was available for the pilot project area. Maps were reviewed for mining symbols (e.g., adits, waste dumps, tailings, etc.) to identify sites to be inspected on the ground.

2. Utah Mineral Occurrence System (UMOS)--Utah BLM contracted the Utah Geological Survey (UGS) to enhance the USGS's Mineral Record Data System (MRDS) data base (Plate 1). The MRDS data base is a computerized mineral resource occurrence inventory. The UGS and Utah BLM have maintained this data base. (UGS sends updates to USGS to translate into MRDS.) The UMOS data base was used to identify known mining sites within the pilot project area. These locations were then verified during the field inspection portion of the pilot project.

3. Mineral Industry Location System (MILS)--The MILS table of the U. S. Bureau of Mines (USBM) Mineral Availability System is a computerized data base which identifies producing mineral locations and processing plants (Plate 1). The USBM office responsible for this data is the Intermountain Field Operations Center. USBM has <u>not</u> maintained this data base for 11-12 years for the Central and Eastern U.S. Therefore, the data base does not identify which of these mines are active and which have become inactive. The inactive mines could be abandoned mines that were not properly closed.

4. Case Recordation System (CRS)/ORCA--The CRS/ORCA is a BLM data base that contains automated case file records of open and closed mining notices and plans of operations, hard rock prospecting permits, nonenergy mining mineral leases, mineral material disposals, and sales data (Plate 1). This data base was used to identify current and past mining activities.

5. Mining Districts--Map 70, entitled <u>Utah Mining District Areas and Principal Metal Occurrences</u>, dated August 1983, by Hellmut H. Doelling and Edwin W. Tooker was used to delineate pilot project mining district boundaries.

6. State of Utah Abandoned Mine Reclamation Program's (AMRP) AML dBase Data Base--This is MRDS information supplemented by AMRP-contracted AML inventories. Once the State of Utah contracts an AML inventory, it involves the cost of inventorying and closing all openings found which are a safety concern. Due to funding restrictions, the State's AMRP is not able to address environmental problems at AML sites. We used this data base to ensure that the State had not already inventoried the proposed pilot project area.

7. Mining District Historical Information and General Geologic Information of Southeastern Utah--Uranium Deposits and General Geology of Southeastern Utah Guidebooks 21 and 9 were used for general geologic information; and Uranium Guidebook for Paradox Basin, Utah-Colorado was read for specific geologic information regarding the Cottonwood mining district.

IV. Field Methodology and Preparation

A. Prefield work

Before field work could begin, an AML site had to be defined. The site definition we used is as follows:

A mine site[3] is defined as a manageable[4] and logical[5] mapping area representing past mining and/or exploration activity in the area. The site should represent the total operation or project area mining-related disturbance. A site may include adits, shafts, pits, waste dumps, tailings, mills, structures and other associated mining-related features[6] and disturbances within the logical mapping area. Access roads associated with the mining activity that have reclamation problems or potential hazardous materials will be included as a site feature.

Exploration drilling may be a site in and of itself when it is distinct and can be determined that a single operator completed the drilling activity (e.g., same drill pad size, use of mud pits, method of plugging holes, etc.). Unreclaimed exploration activity (e.g., drilling, trenching, etc.) with other mining-related activity of a different time period than the surrounding mining-related activity will be a separate site. However, open drill holes or unreclaimed drilling activity intermixed with other mining activity, with no clear distinction that different operators completed the exploration versus the mining, will be included in the site as a mining-related feature.

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[3] This definition was changed during the BLM's State AML Coordinators meeting held on June 1-3, 1994 to the following:

> A site is defined as an area representing unreclaimed inactive or abandoned mining and/or exploration activity. A site may include: adits, shafts, pits, dumps, tailings, structures, access and other associated mining and exploration-related features and/or disturbances.

[4] Manageable is a subjective term used to limit size of a site to a functional (workable) area without using discrete areal limits.

[5] Logical implies features that are closely associated with mining activity.

[6] Features are adits, shafts, pits, etc. associated with the mining activity.

This mine site definition is not synonymous with "site" as defined by Resource Conservation Recovery Act or Comprehensive Environmental Response, Compensation and Liability Act.

The pilot project team decided to inventory everything that was a site on public lands found within the pilot project area, with the exception of mining activity under a current plan of operations, notice, lease, or mineral material permit. This is because it is difficult and sometimes impossible to distinguish between an abandoned[7] and inactive[8] site in the field. The only way to make this determination is an extensive records search back in the office.

The next step was to standardize mapping symbols to be used on site sketch maps to be made in the field. The USGS's National Mapping Program Topographic Symbols pamphlet was used to determined what symbols should be used for the Site Map Symbols list (Figure 7). The prospect symbol was modified to depict whether or not the prospect had collapsed. If a symbol was required that was not on the Site Map Symbols list then the National Mapping Program Topographic Symbols pamphlet (Figure 8) symbols were used.[9]

B. Equipment

Upon completion of site definition and standardization of mapping symbols, a methodology for collection of the site's location and its associated attributes had to be developed. The team decided to collect AML pilot project data with GPS.

The reasons GPS was chosen as an inventory tool were:

- The collection of georeferenced coordinates would allow a site to be navigated to for additional studies. Additional studies would be required if the site were to rank high enough for safety/physical hazards remediation or HAZMAT/environmental site characterization or reclamation remediation.

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[7] Abandoned site is an unreclaimed site for which BLM never had regulatory authority to approve or accept the earth-disturbing activity (e.g., pre-Surface Management Regulations).

[8] Inactive site means an unreclaimed site with reclamation problems for which BLM had regulatory authority.

[9] This list of Site Map Symbols was revised and additional symbols added by the BLM Washington Office. The revised Site Map Symbols and Abandoned/Inactive Mine Land Inventory Field Checklist was available in March 1995.

SITE MAP SYMBOLS

Adit, Caved Adit, Multiple Adits

Prospect

Caved Prospect

Well

Gravel, Sand, Borrow Pit

Mine Shaft

Quarry, Open Pit Mine

DH Drill Hole; if open, note diameter, total depth, wet/ dry bottom of hole

Waste Dump

Rock, Gravel, Sand Pile

Tailings

Excavation

Trench

Paved Road

Dirt Road

Trail

Flowing Creek, Stream

Intermittent Stream

Spring

Bench Mark

Survey Monument (Section Corner) ; note GPS control number if used as control point

Triangulation Station

US Mineral or Location Monument

Slope Up

Slope Down

GPS Perimeter of Disturbed Area

+ GPS GPS Point where Site Checklist was filled out and Site Identification Tag placed.

ID Tag if marker not placed at GPS location

Tree(s)

Photo Point; arrows indicate direction of photo

Structure or Foundation

SITE MAP LEGEND

Site No.: UT-069-00001

Date: 12 July 1993

Location: Township, Range, Section

Total Area Disturbed: 1.2 acres

Technician's Name: John "AML" Doe

North Arrow

1" = 100' Scale (Approximate)

Feature Key used to label photographs & list opening dimensions. The feature identification number corresponds to the site map identification number.

AI . . . numbered sequentially for each adit at site

SI . . . numbered sequentially for each shaft at site

PI . . . numbered sequentially for each prospect at site

TI . . . numbered sequentially for each trench at site

① ② ③ Used to note features on site that should be noted (e.g., mining equipment, transformers, scrap metal, trash etc.). If debris can be quantified put amount in parentisis after location number (e.g., ①(4)). "①" in this case represents transformers and the number "(4)" identifies 4 transformers at this location.

(20/ + 15 (1267)

Scintillometer Reading (CPS)

Height (Above Ground)

Distance from Origin

Figure 7

CONTROL DATA AND MONUMENTS

Aerial photograph roll and frame number* 3-20

Horizontal control

- Third order or better, permanent mark — Nesce
- With third order or better elevation — BM 45.1
- Checked spot elevation — 73.8
- Coincident with section corner — Cactus
- Unmonumented*

Vertical control

- Third order or better, with tablet — BM 18.2
- Third order or better, recoverable mark — 200
- Bench mark at found section corner — BM 18.8
- Spot elevation — 5.3

Boundary monument

- With tablet — BM 21.8
- Without tablet — 73.3
- With number and elevation — B7 30.1
- U.S. mineral or location monument

CONTOURS

Topographic

- Intermediate
- Index
- Supplementary
- Depression
- Cut; fill

Bathymetric

- Intermediate
- Index
- Primary
- Index Primary
- Supplementary

BOUNDARIES

- National
- State or territorial
- County or equivalent
- Civil township or equivalent
- Incorporated city or equivalent
- Park, reservation, or monument
- Small park

*Provisional Edition maps only

Provisional Edition maps were established to expedite completion of the remaining large scale topographic quadrangles of the conterminous United States. They contain essentially the same level of information as the standard series maps. This series can be easily recognized by the title "Provisional Edition" in the lower right hand corner.

LAND SURVEY SYSTEMS

U.S. Public Land Survey System

- Township or range line
- Location doubtful
- Section line
- Location doubtful
- Found section corner; found closing corner
- Witness corner; meander corner — WC MC

Other land surveys

- Township or range line
- Section line
- Land grant or mining claim; monument
- Fence line

SURFACE FEATURES

- Levee — Levee
- Sand or mud area, dunes, or shifting sand — Sand
- Intricate surface area — Strip mines
- Gravel beach or glacial moraine — Gravel
- Tailings pond — Tailings Pond

MINES AND CAVES

- Quarry or open pit mine
- Gravel, sand, clay, or borrow pit
- Mine tunnel or cave entrance
- Prospect, mine shaft
- Mine dump — Mine dump
- Tailings — Tailings

VEGETATION

- Woods
- Scrub
- Orchard
- Vineyard
- Mangrove

GLACIERS AND PERMANENT SNOWFIELDS

- Contours and limits
- Firn lines

MARINE SHORELINE

Topographic maps

- Approximate mean high water
- Indefinite or unsurveyed

Topographic-bathymetric maps

- Mean high water
- Apparent (edge of vegetation)

COASTAL FEATURES

- Foreshore flat
- Coral reef
- Kelp or seaweed
- Group of rocks bare or awash
- Exposed wreck
- Depth curve; sounding
- Breakwater, pier, jetty, or wharf
- Seawall

BATHYMETRIC FEATURES

- Area exposed at mean low tide; sounding datum
- Channel
- Offshore oil or gas well; platform
- Sunken rock

RIVERS, LAKES, AND CANALS

- Intermittent stream
- Intermittent river
- Disappearing stream
- Perennial stream
- Perennial river
- Falls; small rapids
- Falls; large rapids
- Masonry dam
- Dam with lock
- Dam carrying road
- Perennial lake; intermittent lake or pond
- Dry lake
- Narrow wash
- Wide wash — Wash
- Canal, flume, or aqueduct with lock
- Elevated aqueduct, flume, or conduit
- Aqueduct tunnel
- Well or spring; spring or seep

SUBMERGED AREAS AND BOGS

- Marsh or swamp
- Submerged marsh or swamp
- Submerged wooded marsh or swamp
- Rice field
- Land subject to inundation

BUILDINGS AND RELATED FEATURES

- Building
- School; church — S
- Built-up Area
- Racetrack
- Airport
- Landing strip
- Well (other than water); windmill
- Tanks
- Covered reservoir
- Gaging station
- Landmark object (feature as labeled)
- Campground; picnic area
- Cemetery: small; large — Cem

ROADS AND RELATED FEATURES

Roads on Provisional edition maps are not classified as primary, secondary, or light duty. They are all symbolized as light duty roads.

- Primary highway
- Secondary highway
- Light duty road
- Unimproved road
- Trail
- Dual highway
- Dual highway with median strip
- Road under construction
- Underpass; overpass — U O
- Bridge
- Drawbridge
- Tunnel

RAILROADS AND RELATED FEATURES

- Standard gauge single track; station
- Standard gauge multiple track
- Abandoned
- Under construction
- Narrow gauge single track
- Narrow gauge multiple track
- Railroad in street
- Juxtaposition
- Roundhouse and turntable

TRANSMISSION LINES AND PIPELINES

- Power transmission line; pole; tower
- Telephone line — Telephone
- Aboveground oil or gas pipeline
- Underground oil or gas pipeline — Pipeline

Topographic Map Symbols

Figure 8

U.S. Department of the Interior
U.S. Geological Survey

Reading Topographic Maps

Interpreting the colored lines, areas, and other symbols is the first step in using topographic maps. Features are shown as points, lines, or areas, depending on their size and extent. For example, individual houses may be shown as small black squares. For larger buildings, the actual shapes are mapped. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps post offices, churches, city halls and other landmark buildings are shown within the tinted area.

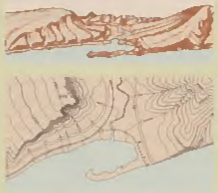
The first features usually noticed on a topographic map are the area features such as vegetation (green), water (blue), some information added during update (purple), and densely built-up areas (gray or red).

Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination. The colors of the lines usually indicate similar kinds or classes of information: topographic contours (brown); lakes, streams, irrigation ditches, etc. (blue); land grids and important roads (red); other roads and trails, railroads, boundaries, etc. (black); and some features that have been updated using aerial photography, but not field verified (purple).

Various point symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells.

Names of places and features also are shown in a color corresponding to the type of feature. Many features are identified by labels, such as "Substation" or "Golf Course."

Topographic contours are shown in brown by lines of different widths. Each contour is a line of equal elevation; therefore, contours never cross. They show the general shape of the terrain. To help the user determine elevations, index contours are wider. Elevation values are printed in several places along these lines. The narrower intermediate and supplementary contours found between the index contours help to show more details of the land surface shape. Contours that are very close together represent steep slopes. Widely spaced contours, or an absence of contours, means that the ground slope is relatively level. The elevation difference between adjacent contour lines, called the contour interval, is selected to best show



Ground configuration shown by contours

the general shape of the terrain. A map of a relatively flat area may have a contour interval of 10 feet or less. Maps in mountainous areas may have contour intervals of 100 feet or more. The contour interval is printed in the margin of each U.S. Geological Survey (USGS) map.

Bathymetric contours are shown in blue or black depending on their location. They show the shape and slope of the ocean bottom surface. The bathymetric contour interval may vary on each map and is explained in the map margin.

Topographic Map Information

For more information about topographic maps produced by the USGS, please call 1-800-USA-MAPS.

What is a Topographic Map?

A map is a representation of the Earth, or part of it. The distinctive characteristic of a topographic map is that the shape of the Earth's surface is shown by contour lines. Contours are imaginary lines that join points of equal elevation on the surface of the land above or below a reference surface such as mean sea level. Contours make it possible to measure the height of mountains, depths of the ocean bottom, and steepness of slopes.

A topographic map shows more than contours. The map includes symbols that represent such features as streets, buildings, streams, and woods. These symbols are constantly refined to better relate to the features they represent, improve the appearance or readability of the map, or to reduce production cost.

Consequently, within the same series, maps may have slightly different symbols for the same feature. Examples of symbols that have changed include built-up areas, roads, intermittent drainage, and some type styles. On one type of large-scale topographic map, called provisional, some symbols and lettering are hand drawn.

The cover, a portion of the Elizabethtown, Kentucky, area, demonstrates how map symbols represent features on the Earth's surface. The bottom third, an aerial photograph, shows the Earth as seen from above; the middle part portrays some of the features on the aerial photograph that will be symbolized on the map; and the top third shows the finished map.

- The Abandoned Mined Lands Field Inventory Data Sheet could be collected digitally. Site attributes are tied to the site once the georeferenced coordinates are differentially corrected. Site attributes (the BLM's Abandoned Mined Lands Field Inventory Data Sheet) provided the information required to rank a site. In addition, attributes may be queried as soon as the associated georeferenced coordinates are differentially corrected. (There is no time delay between collecting the data in the field and waiting for someone to input the data into a data base for further analysis.)

- The georeferenced coordinates would allow the site to be located correctly on a topographic map. This avoids mapping errors resulting from misreading a topographic map.

The GPS equipment available to us was the Trimble Navigation Pathfinder Professional unit. Pathfinder contains a suite of PFINDER software. PFINDER software runs on a PC and is composed of PFINDER, PROPLAN, and the utility programs. PFINDER software that runs on the datalogger (MC-V) is PATHLOG. One additional program, KERMIT, runs on both the MC-V and the PC to allow files to be transferred back and forth between these pieces of equipment.

C. AML Site Attributes

Once the methodology and equipment for the field portion of the pilot project were determined, the information needed to rank an AML site had to be established. The BLM Washington Office requested all field offices to review and comment on the Draft Abandoned Mined Land Field Inventory Form[10]. We used the Abandoned Mined Lands Field Inventory Data Sheet (Appendix 1) to build the first data dictionary for the datalogger (MC-V).

A Pathfinder data dictionary contains details about the kinds of information to collect. The data dictionary is created in PFINDER[11] and consists of the following elements: (1) features, (2) a list of attributes for each feature, (3) for each attribute, a description

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[10] The Draft BLM Abandoned Mined Land Field Inventory Form was replaced by BLM Abandoned Mined Lands Field Inventory Data Sheet. The data sheet was revised in 1994. The 1994 version was entitled Abandoned/Inactive Mine Land Inventory Field Checklist. This checklist was revised again in March of 1995 and has the same title as the 1994 version. The 1995 checklist is the current checklist for AML inventories.

[11] PFINDER is menu-driven, and a mouse is recommended. Computer documentation was provided in June of 1995 for the Abandoned/Inactive Mine Land Inventory Field Checklist.

of the characteristics of that attribute (e.g., type, default values, and range of possible values, etc.). The feature is classified as a point, line or polygon. An attribute can be one of five different types: Numeric, character string, date, time or menu.

The BLM Abandoned Mined Lands Field Inventory Data Sheet was used to create the data dictionary. The data dictionary (AML_SITE.DDF) included four separate features for the AML pilot project. These features were the data sheet (AML_SITE), access road (AML_ROAD), perimeter(s) of the site (AML_PERIMETER), and point features (AML_POINT) for significant features within the site that were difficult to find or considered a safety risk (e.g., shafts, open drill holes, etc.).

The data sheet feature was classified as a point. There were 189 attributes on version 5 of the data sheet. A polygon feature (e.g., open pits, waste dumps, etc.) was used to classify the perimeter of surface disturbance within the site; a line feature was used to classify the access road to a site; and another point feature was used to classify significant, hard-to-find, or dangerous site features (e.g., open drill hole, adits, shafts, etc.) within the site.

Once the dictionary has been created on the PC using PFINDER, then it is downloaded to the MC-V datalogger. The transfer of the data dictionary to the MC-V is menu-driven on both the PC and the MC-V datalogger. Appendix 2 is the data dictionary for the Abandoned Mined Lands Field Inventory Data Sheet used for collection of site-attribute data for the Cottonwood mining district.

D. Premission Planning

Prior to commencement of field work, a new almanac was collected for the receiver and uploaded to the datalogger. The almanac was then downloaded to the laptop and displayed in PROPLAN to determine satellite availability and subsequently the best time to collect coordinates for a site (Figure 9).

V. Field AML Site Identification

A. Field Methodology

A reconnaissance of a portion of the pilot project area was completed in order to identify sites. Once the site boundaries were established, a reconnaissance of the site itself was completed. During this reconnaissance, a sketch map of the site was drawn. All attributes of the site (e.g., shafts, adits, waste dumps, etc.) were depicted on the sketch, using Site Map Symbols list (Figure 7), supplemented by National Mapping Program Topographic Symbols (Figure 8) if the symbol did not appear on the team's list.

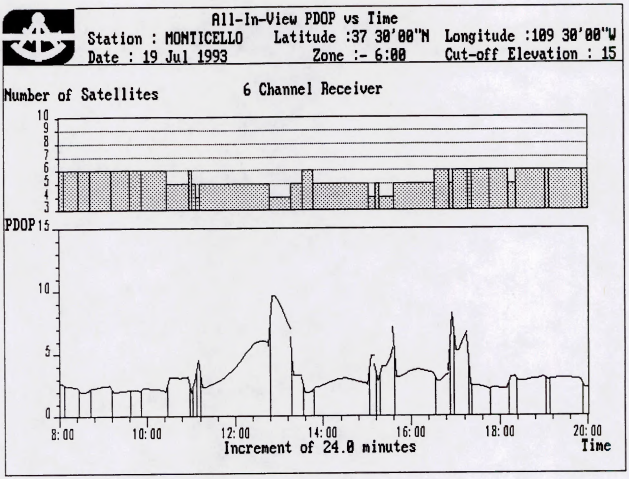
All-In-View PDOP vs Time
Station : MONTICELLO
Latitude :37 30'00"N
Longitude :109 30'00"W
Date : 19 Jul 1993
Zone :- 6:00
Cut-off Elevation : 15
Number of Satellites
6 Channel Receiver
10
9
8
7
6
5
4
3
PDOP 15
10
5
0
8:00
10:00
12:00
14:00
16:00
18:00
20:00
Time
Increment of 24.0 minutes

Figure 9

After all attributes of the site were identified and sketched, each attribute was given an identification number on the map (e.g., the first adit was given the identification number A1; the second adit within the site would be A2, etc.; Shafts were identified by S1, S2, etc.; Prospects were identified by P1, P2, etc.). Once each attribute was labeled, dimensions and photographs were taken. If appropriate, pH and conductivity readings were also taken. A photograph log (Figure 10) was used to expedite the labeling of photographs after the film was developed. The identification number of each attribute allowed the photograph to be cross referenced easily with the site sketch map.

The sketch of the site also helped to fill out the Abandoned Mined Lands Field Inventory Data Sheet. The field data sheet and the sketch map should have the same total number of mining features within the site. Once the data sheet was completed, a point was chosen to represent the site. This point is where the site feature AML_SITE was recorded on the datalogger (AML_SITE portion of the AML_SITE.DDF data dictionary). Hard-to-find point features within the site boundaries, such as open drill holes, were recorded on the datalogger under AML_POINT feature. Roads that were difficult to find were also recorded under the AML data dictionary, AML_ROAD feature. The sketch map also included the approximate position of the AML_PERIMETER which allowed the computer operator in the office to smooth perimeter lines on the electronic map. The team also completed site perimeters to eventually compare site disturbance between the digital record and the estimate of the field personnel.

All sites inventoried during the day were recorded on a base map. A description of all remote sensing locations inspected were also noted on the base map, if they were not sites. This information will be used to refine remote sensing data interpretation to increase its accuracy.

If a safety concern was noted on the site, such as a shaft at the base of a hill, the team would sign the feature with a "Danger Open Shaft" sign. These signs are available to BLM through the BLM Service Center in Denver.[12] Upon completion of all of the above steps, the team went onto the next site and repeated the procedures outlined above.

At night, back at the BLM office/trailer, the day's work was downloaded from the MC-V datalogger into the laptop computer. Using PFINDER, a directory was created. The directory-naming convention used the date that the file was collected in the field. PFINDER was then used to display the data collected. These steps were done nightly in order to ensure data was properly collected and that the file was transferred intact

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[12] Additional AML safety signs may be available through the National Park Service Mining and Minerals Branch Lands Resources Division (Appendix 3).

PHOTOGRAPH LOG

Roll No.	Frame No.	Direction Facing	Description of Photo

Figure 10

from the MC-V into the laptop. If the data was not properly collected, it was recollected the next day. (Since the map displayed on the laptop had not been differentially corrected, it sometimes did not look like the site as depicted on the sketch map.) The downloaded data on the laptop was also backed up onto a disk. Once the files were displayed in PFINDER and backed up on the disk, the MC-V was cleared of the day's work and plugged in to be recharged for the next day's work.

The downloaded files have two extensions. These extensions are *.SSF and *.T. The *.SSF extension file is used to differentially correct the rover files. Differential correction is necessary to correct for selective availability (SA). SA is used by the Department of Defense to degrade the GPS signal for security reasons. Errors resulting from SA are almost entirely removed by differential correction. The principle behind differential correction is a base station with a known latitude, longitude, and elevation is collecting satellite data at the same time the rover or remote is collecting satellite data at an unknown location. Therefore, if the base station data is 200 feet from the known location, then the rover file, at that exact same time, will be offset 200 feet as well.

The accuracy of GPS coordinates degrades as the distance from the base station increases. Originally the team differentially corrected using the Salt Lake City, Utah, base station. The accuracy was not what the team had hoped for; so the team then tried the Mesa Verde, Colorado, base station. Since the Mesa Verde base station was closer to the pilot project area (which must be within appropriately 300 miles of the base station to obtain the best results), the team was able to correct the data to an accuracy of approximately 3-5 meters (Pinkney and Trotter, 1992).

The files were brought back to Salt Lake City to be differentially corrected. (Eventually we hope to differentially correct in the field.) Once corrected, the files were exported to AutoCAD in a *.DXF file format and eventually to ArcCAD. In AutoCad, individual site maps were edited by comparing the site sketch map with the GPS map of the site. All the sites were combined into one data set to generate a map of the pilot project area.

Two factors to keep in mind while using GPS equipment are the location of sites down in canyons and the location of the field vehicle. The canyon may prevent the GPS antenna from receiving 3 satellites' signals allowing the receiver to get a position fix, and 4 satellites for an elevation fix. If the field vehicle is parked too close to the site, it could cause multipathing. Both these factors can be easily identified in post-processing of the data, but should be avoided.

It is important to note that proper battery maintenance of the MC-V and receiver batteries is necessary to ensure the longevity of the batteries and prevent unnecessary downtime due to power problems. The MC-V battery is an internal, rechargeable, Ni-Cad battery and therefore should <u>not</u> be recharged until the battery is functioning at

35 percent or less. When the battery on the datalogger is functioning at 35 percent or less, the external battery is turned on. If data is collected and the datalogger battery is discharged before the external source is turned on, the data is lost. The receiver battery is a lead acid battery and is recharged overnight after it has been used during the day.

B. Safety

All individuals working in the field on this project were informed of the potential dangers in and around old mine workings, such as loose material around shaft collars, rotten timbers, explosive magazines, etc. This information was reiterated with the viewing of the video entitled, "Utah's Abandoned Mines Stay Out and Stay Alive!" (A Video on Abandoned Mine Safety).

In addition, the BLM Utah State Office Hazardous Substances Contingency Plan, Chapter 2, "Hazardous Substances Safety Procedures," was given to AML inventory participants to read and take to the field with them. Also, field personnel attended a Chemical Management/Hazardous Material Recognition/Safety for AML Inventory Personnel developed from the National Training Center course FP1703-7/11TT. Also, procedures outlined in BLM Instruction Memorandum No. UT 94-123 were used to reduce the risk of exposure to the Hantavirus disease since the team was working in the vicinity where this disease was reported.

Since all information on the Abandoned Mined Lands Field Inventory Data Sheet could be obtained outside the mine workings, the policy was no personnel should enter any mine opening or structure during the inventory of a site. Also, inventory personnel had to work in a team of two.

An additional consideration that had to be addressed was radiation, since this mining district produced uranium ore. Scintillometer readings and opening dimensions were taken at the portal. Measurements and readings were taken as quickly as possible to minimize potential radiation exposure time. High scintillometer readings indicated the need for the inventory personnel to leave the portal area.

In order to devise a safety plan to address radiation concerns, the natural decay of the uranium ores must be understood. Uranium-bearing ores contain a suite of radioactive elements. Each radioactive element decays at a different rate. The half-life of the parent uranium is 4½ billion years. Radium, a disintegration product of uranium, has a half-life of 1,622 years; radon, a gaseous product formed by disintegration of radium, has a half-life of 3.8 days.

The ionized radiation related to uranium mines can occur in many forms. Generally, the forms are particulate and electromagnetic radiation. Alpha and beta particles are examples of particulate radiation, while gamma and x-rays represent electromagnetic

radiation. The alpha emitters, radon daughters, are the direct descendants of radon gas. Radon and thoron daughters become attached to airborne dust in the mine air and can be inhaled by individuals working in the mine. Proper mine ventilation can reduce the dust to acceptable levels. Individuals who smoke cigarettes and are exposed to airborne radiation in mines or mills may increase their risk of cancer of the lungs tenfold.

The concern over high levels of airborne radiation is the long-term health effects. Several articles in the New England Journal of Medicine[13] have documented that the risk of lung cancer increases in relation to both estimated cumulative and time-weighed exposure to radon.

Exposure to radiation involves two measurements, the level of radiation and the length of exposure in terms of time. The unit used for measuring the levels of airborne radiation is known as working level (WL). Individuals should not spend time in areas where high levels of radiation are known to exist. The present health standard is 4 working level months (WLM) in a calendar year. An individual's exposure should be kept below this maximum allowable dose.

We recommend that future inventory personnel use the following the guidelines:[14]

- Baseline physicals prior to participating in the AML inventory effort. Baseline physical includes physician examination, chest x-ray, pulmonary function study and blood work consisting of Complete Blood Count (CBC) and Chem panel. This is primarily to determine if any prior medical problems exist.

- Post-survey examination only if a concern exists that a substantial exposure or other adverse event occurred.

- Washing hands and face prior to eating will prevent ingesting radon particles which have adhered to dust particles on hands and face.

- Use of overalls or other appropriate clothing that would be taken off after surveys to avoid the possibility of carrying any contaminant back to the office or home.

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[13]Refer to New England Journal of Medicine articles "Radon and Lung Cancer In Mines and Homes," "Lung Cancer in Swedish Iron Miners Exposed To Low Doses of Radon Daughters," and "Uranium Mining and Lung Cancer in Navajo Men," Vol 310, No. 23, June 7, 1984.

[14]Letter from Doctor Terry Allen Brown to Terry McParland, January 24, 1995.

- Use of properly calibrated portable scintillometer on site for continuous reading of gamma radiation which can be converted to WL or alpha radiation exposure levels.

In addition, we recommend that this policy include the provision that if the WL is monitored above 1, the inventory personnel should leave the area around the mine portal.

VI. Data Base Development

The data base generation strategy identified the following steps:

- Export of differentially corrected field data (e.g., coordinates and attributes) from Pathfinder to an appropriate Geographic Information System (GIS) software data format.

- Import of differentially corrected field data to the identified GIS application software.

- Subsequent GIS processing of field data to generate a spatial (GIS) theme of AML data. The final AML theme may be combined as needed with other base data and resource data themes for spatial analysis and product output.

A. AML Data Base Generation Process

The data-processing strategy was developed in preparation for the Bureau's target system. The Automated Lands and Minerals Records System (ALMRS) modernization includes a transition of GIS technology from mainframe computer to UNIX workstation platforms and from the Bureau's current GIS software, MOSS, to Arc/Info, by Environmental Systems Research Institute (ESRI), Inc.

ArcCAD[15], produced by ESRI, Inc., was used as a substitute GIS application software for the AML pilot project since the cost of purchasing and installing the software and required hardware for the target system prior to June 1994 was beyond the AML pilot project budget. It was expected that ArcCAD would provide an efficient means of generating Arc/Info-compatible data bases so that data base generation could continue in the absence of Arc/Info until the target system installation was

[15]ArcCAD is an IBM PC-based collection of GIS software routines that works as a third-party application within the AutoCAD environment. AutoCAD (by Autodesk, Inc.) is a Computer-Aided Drafting (CAD) program commonly used by engineering, survey, and mapping personnel in the Bureau.

complete. ArcCAD uses the same data model as Arc/Info and generates an Arc/Info-compatible data-export format. While advanced GIS functions offered with ArcCAD are limited compared to Arc/Info, the basic routines required to generate a spatial data base are similar.

While Arc/Info was not directly available in the BLM Utah State Office (USO) in 1993, our personnel had access to UNIX-based Arc/Info user accounts at the University of Utah Geography Department through the Mapping Sciences cooperative-education students. Access was limited for the purposes of the AML project but did allow personnel to extend processing strategies to the target system GIS software. Since modernization resources were not directly available until June of 1994, the processing strategy was adapted for PC. This has since been redesigned for the ALMRS target platform.

B. Issues/Problems Encountered

The following problems were encountered during the post-collection data processing phase of the AML pilot project. While the USO process strategy has been redesigned for the Arc/Info environment, discussion of problems related to the AutoCAD/ArcCAD environment are included for users who do not yet have access to the Arc/Info platform for post-processing.

The Trimble Technical Support personnel have been accommodating, helpful, and timely in attending to the Bureau's software-related problems. There are two particular problems related to the export of GIS data from Pathfinder:

1. Pathfinder (pre-2.51 versions) terminates the length of character-type attribute values at 20 characters regardless of larger defined lengths in Pathfinder data dictionaries, resulting in loss of data.

The Trimble Pathfinder Software Reference, Rev.C, v2.3, Sept, 1992, p.157 states that Pathfinder software allows users to define character fields in data dictionaries up to 256 characters long. However, our team experienced abnormal termination of data in the "comment" and other character fields (greater than 20 characters) in the AML_SITE data dictionary at 20 characters. Trimble has corrected this problem in Pathfinder v2.51, allowing the proper export of up to 256 characters in data fields.

2. Pathfinder export routines do not take into account Arc/Info limitations for importing the exceptionally long data records that result from extensive AML data dictionaries. Manual editing of Pathfinder-exported data records is required for import to Arc/Info. More detailed explanation appears under section F, "Pathfinder Export to Arc/Info-Info and Arc/Info-dBase."

C. Problems/Concerns Related to AutoCAD/ArcCAD

1. Single- vs. Double-Precision Coordinate Values: ArcCAD v11.2 only maintains coordinate values in single-precision (8 places, including decimal). USO personnel were informed at an ESRI, Inc. new product demonstration (June, 1994) that the newest version of ArcCAD will not be limited to single-precision accuracy. Workstation Arc/Info does not share this limitation.

2. AutoCAD Block Insertion Points: Writing AutoCAD block insertion points to (0,0) rather than the feature centroid. A block is a collection of several AutoCAD entities that are packaged together and treated as one unit/entity. In the AML pilot project, GPS-collected spatial entities are written into a block along with the text-entities (attribute values) entered in the MC-V datalogger for each element in the data dictionary.

When AutoCAD entities that have attributes (e.g., "blocks") are added to an ArcCAD coverage, the spatial coordinates added to the ArcCAD coverage data base are not those of the entity itself but of the block in which it is contained. The point entity is not actually added to the coverage. The block is the entity actually added to the coverage, mirroring the coordinates of the point. This is why it is critical that the block insertion point coordinates match the coordinates of the point entity itself.

To add text to an AutoCAD drawing, the text entity that represents the desired character string is created and placed at a specific x,y location in the drawing. However, text entities (GPS attribute values) in Pathfinder-created blocks are not automatically assigned x,y locations. When these blocks are "exploded," the text entities by default are located at that block's insertion point. This concept becomes critical when generating a data base of polygon features and their descriptive attributes in ArcCAD from *.DWG files.

When defining new blocks, AutoCAD prompts the user for an x, y location that will become the block insertion point. When a Pathfinder block includes a single-point entity, the block insertion point should be the x, y coordinates of the point. When a block includes a polygon representing an area boundary (AML_PERIMETER) and the attributes associated with that polygon, the block insertion point should be assigned an x, y coordinate within the boundary of the polygon. This is critical for relating polygon-attribute data to a polygon boundary when building a spatial data base in ArcCAD. Fortunately, Pathfinder v2.40 allows the user to choose the feature centroid as the block insertion point when exporting GPS-collected data to blocks in an AutoCAD drawing interchange (*.DXF) file.

3. Number of ArcCAD-dBase File(*.DBF) Items: There is supposed to be a limitation to the number of attributes/items (according to ArcCAD User's Guide this limitation is 128 items) in dBase-compatible files (AAT.DBF, PAT.DBF). However, this was not

actually a problem for the AML pilot project. The team exceeded 128 without any problems. This should be investigated further.

D. ArcCAD and Arc/Info Export File Format

USO personnel have demonstrated that ArcCAD (IBM-PC) and Arc/Info (UNIX) export file formats (*.E00) are compatible, provided that the export files are converted between operating system platforms using UNIX2DOS/DOS2UNIX (SunOS 4.1.3) routines. Arc/Info export files facilitate the transfer of GIS data between ArcCAD and Arc/Info softwares/platforms. UNIX2DOS conversions install carriage-return/line-feeds (CR/LF) and end-of-file (EOF) markers in export files for the benefit of the DOS operating system. DOS2UNIX conversions remove CR/LF and EOF markers from the files so that they may be read properly in UNIX.

E. Spatial Accuracy of GPS Positions

The accuracy of GPS-collected resource grade data is potentially within 2-5 meters[16]. For the pilot project, GPS-collected data was exported from Pathfinder with "Any SV Configuration" and "Corrected Only" options selected (see Pathfinder "Output/GIS/Options/Data Type" menu). Visual inspection of the GPS positions, overlaid with 1:24,000 scale base data in AutoCAD, suggests no significant anomalies in positional accuracy considering the scale of the base data. While the data may not meet National Map Accuracy Standards, there is no reason to believe that this data is inappropriate for use as a resource data theme when combined with other 1:24,000 scale or smaller scale base data and resource data themes.

F. Pathfinder Export to "Arc/Info-Info" and "Arc/Info-dBase"

Pathfinder export routines generate a series of data files and batch files[17] for each feature type--points, lines, polygons. One file's data will contain the coordinate values that define the spatial feature, while attribute records are contained in a different file, referenced to the coordinate pairs by an index number.

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[16]Refer to Trimble Pathfinder Software "General Reference," and to Pinkney, E.J., and C.M. Trotter, "Collecting Accurate Ground Control Data Using Non-Geodetic GPS Receivers," Proceedings: 6th Australasian Remote Sensing Conference, Wellington, New Zealand, Vol. 1. 2-6 November, 1992.

[17]Batch files are written by Pathfinder to automate the import of positions and attributes into a third-party software package (e.g., ArcCAD or Arc/Info). These batch files, however, require some editing for proper import of Pathfinder data to Arc/Info.

Attribute data is exported for Info as a comma-delimited ASCII record greater than 500 characters long. While Info can store up to 4000 characters in an Info table record, it cannot read greater than 200 characters from an ASCII record at a given time. Therefore, Arc's TABLES command is used. TABLES will read up to 1000 characters in a comma-delimited, ASCII record. However, character-type fields must be enclosed in quotation marks ("") when importing to TABLES. Pathfinder's "Arc/Info-dBase" export routine will export character fields in quotes but also writes (overwrites) the same series of data files and batch files configured for PC-Arc/Info using dBase format for its Info tables. Therefore, a specific order must be followed in executing the export routines for successful export.

The following describes the order of operations for successful export of Pathfinder data to Arc/Info (that will yield character fields in quotations for TABLES):

- Export data once as "Arc/Info-Info" to get the (x,y) coordinate files needed for GENERATE (*.GEN).

- Export data again as "Arc/Info-dBase" to get comma-delimited ASCII file of records of attribute data with character fields in quotation marks (*.AA, *.PA).

- Edit the file containing the data base table item-definitions (*.INF) into the Arc/Info processing script (*.AML), correcting for "floating-point" item-definitions and unnecessary spaces (specific instructions are defined in the processing scripts).

- Copy script, coordinate, and attribute files to the workstation platform.

- Run processing script within Arc/Info.

There are potential problems with this strategy that deserve discussion. Due to the overall size of the data dictionary and the character-length of some data fields, ASCII attribute records for a given feature have the potential to extend over 1500 characters if all fields are filled with the maximum number of characters. This length for an attribute record is not accommodated by the current processing strategy. USO personnel are currently investigating the possibility of splitting long records into several files of a certain field length, using the Unix command/programming language, "AWK."[18] This would allow the use of INFO to import attributes rather than

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[18]AWK is a Unix pattern-scanning and processing language that scans input files for lines that match a specific pattern set, and may perform specified actions when a match is found. There are also public-domain DOS incarnations of AWK that may be investigated as well. Refer to Aho, A.V., B.W. Kerninghan, P.J. Weinberger, *The AWK Programming Language*, Addison-Wesley, 1988.

TABLES, and thereby eliminate the need to export data twice from Pathfinder (refer to discussion of "character fields in quotations (""),," above).

If "AWK" is incorporated with the processing strategy, to split records, then the "Arc/Info-dBase" export becomes unnecessary since quotations for character fields are no longer necessary. It will be important to realize that the fields in ASCII records are separated by a specific "delimiter"--in this case, the comma (,). If unquoted character-type fields (from the "Arc/Info-Info" export) contain the delimiting character as part of the data obtained in the field, the programs that process that data (e.g., Info and AWK) may mistakenly consider the comma in the character field a delimiter, ending that field at the comma and beginning the next field with the immediately following character. This may result in an incorrect field-length count, or cause data-type incompatibility errors if, for example, the rest of the split character field spills over into a decimal number-type field definition. Therefore, if the delimiter in the ASCII export file is a comma (defined by the Pathfinder software), then commas should be avoided when collecting and entering data in a character-type field.

G. Problems to Address Prior to Field Collection

1. Naming Conventions: There were 189 named attributes identified by AML specialists for describing/characterizing individual disturbance sites. Each attribute name had to meet name-length (length of an attribute name) and character-set (set of acceptable characters used in a name) restrictions for the three software packages used in the pilot project; Pathfinder, AutoCAD, and ArcCAD. For attribute names to complete a smooth transition from Pathfinder to ArcCAD, the attribute names as defined in the Pathfinder data dictionaries must conform to the restrictions of all three softwares. While name-length and character-set restrictions were detailed in each software user manual, USO personnel performed extensive data editing and manipulation to make multiple data sets conform to the restrictions of all three softwares. In future data-collection, data dictionary attribute names will conform to all restrictions.

2. Changes to Data Dictionaries: The AML pilot project process, by nature, involves dynamic refinement of data collection, processing, and analysis methods. Specifically, the field data collection sheet and the Pathfinder data dictionary, as templates for AML data, changed five times during the first data-collection season. New attribute items were added to the data sheet while others were deleted, and attribute items in the data dictionary changed data types and field widths as field collection and processing experiences identified shortcomings in the previous formats. The implications of these changes are serious when the user attempts to incorporate data sets collected with different dictionaries.

The common data types include character, integer, decimal, and date. Width of fields or placement of decimal points is critical for successful import of attribute data.

A data dictionary is embedded within each Pathfinder data file (*.SSF/*.COR). Pathfinder allows this embedded data dictionary to be replaced with other Pathfinder data dictionaries. The Pathfinder command for this is RPDD, and is run from the (DOS) operating system (e.g., outside of Pathfinder, at the command prompt). This provides a means for editing dictionary templates. Most often the editing is to correct spelling errors in attribute names, but data base item/field definitions may be added/deleted in the original dictionary as well, or RPDD could be used to replace the original dictionary with an altogether new version.

It is important to note, however, that attribute data entries themselves are recorded in sequential order in the data record according to the order of the items in the dictionary with which the data was collected (personal communication with Trimble Service Representative, October, 1994). Therefore, if the original data dictionary used to collect the data and embedded in the file is replaced with a dictionary that has been edited (such that data items are in a different order from that with which they were collected), the data entries may not be reliably retrieved (entries would no longer be in the correct sequential order in the data record). This is especially true if the new order of attribute items in the dictionary puts different data types in the wrong sequence; for example, an integer item (in the dictionary) in the place of a character item (in the data record).

3. Standardizing Data Dictionaries and Determining In-field/In-office Data: The data dictionary used for the Utah pilot changed five times during the period of field collection and is expected to change again. However, timely effort should be made at the national level to identify and standardize the minimum site characteristics necessary to determine potential hazard and priority for reclamation. It is essential for the purpose of collecting a national data base that all States' inventory efforts employ the same data standards, definitions, and minimum required data items. Fewer attributes facilitate collection, processing and data base generation, and afford a more manageable data base. This problem was recognized by AML Coordinators at the AML Conference in Salt Lake City, Utah, in June 1994.

After the minimum site characteristics have been identified they should be sorted into two classes of attributes--those collected "in the field" and those generated "in the office" by GIS analysis/processing or other means. Separating in-field and in-office attributes has several advantages. Time spent on-site by field personnel is reduced if field technicians are not required to determine data values for attributes that may be just as easily or more easily determined in-office. This allows more sites to be inventoried, less training of seasonal field technicians, and fewer opportunities for error based on "judgement calls" by less experienced technicians. Opportunities for utilizing the full potential of GIS analysis are increased by identifying prior to field work

which attributes may/may not be efficiently determined using GIS tools. AML personnel should consult with their GIS specialists about which attribute values may be efficiently determined using GIS tools.

H. Area Perimeters

As site maps are sketched "in the field," field technicians should take care to sketch the perimeter line that they walk for AML_PERIMETER features. Regardless of SA, spatial accuracy, differential correction, etc., there will inevitably be some linework that will require manual editing to be "cleaned up." In-office technicians will require some source data to assess the accuracy of field-collected perimeter lines. Rough site map sketches should show a line that indicates the approximate shape, size, and position of the AML-PERIMETER.

VII. Ranking Program Development

The ranking program utilizes the data sheet to assign values to site attributes to rank the site into three categories. These categories are: physical/safety hazards, environmental/hazardous materials, and reclamation.

Two different algorithms were used to rank physical/safety hazards. The first algorithm weights the individual hazards from 0 to 1 based on the number of occurrences, and then weights the total based on a weighing factor for each hazard. The final solution is then normalized between 0 and 1. This algorithm is known as PY_NORM, and the histogram is skewed heavily towards 0 (see Figure 11). The second algorithm multiplies the number of occurrences times the weighing factor and then normalizes the cumulative points between 0 and 1. This algorithm is known as PY_LINER and the histogram is also skewed heavily towards 0 (see Figure 12). It should be noted that since the solutions occur between 0 and 1, the data can be forced to a normal distribution by taking roots of the rank. A histogram showing the cube roots can be seen in Figure 13.

The environmental/hazardous materials ranking is divided into four major methodologies with the final weighing factor being normalized to occur between the values of 0 and 1. Potential human targets were weighted according to the distances from the site to the target. Environmental hazards were weighted by whether the hazard existed or not. Radiation was weighted by counts with values greater than 2000 counts per second obtaining full weight. The pH was weighted for acidity and alkalinity with full weight occurring at a pH of less than 2 or greater than 12. Conductivity was weighted with 0 for values less than 1000 and maximum weight for values greater than 2000. The histogram for the solution of the pilot data appears to emulate a normal distribution as depicted in Figure 14.

PHYSICAL SAFETY RANKING

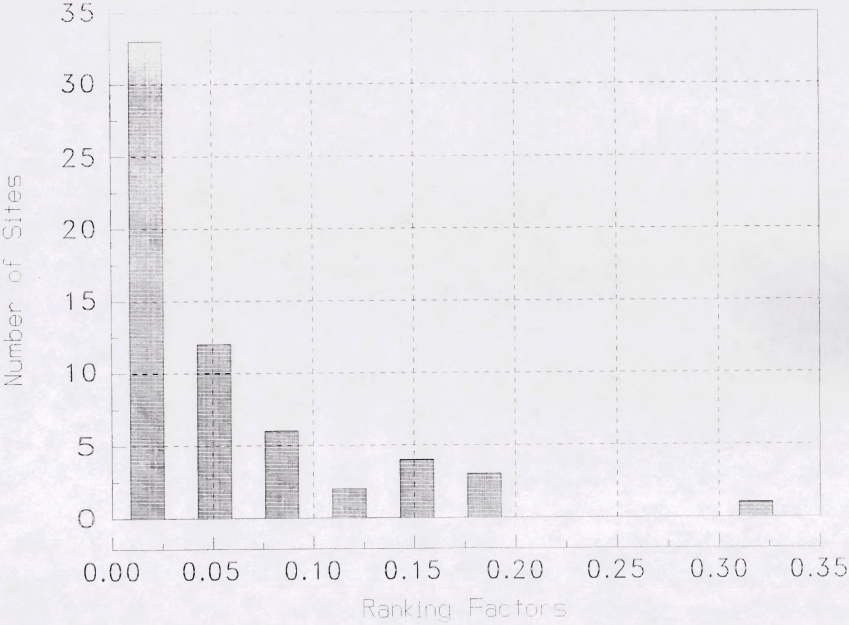

Figure 11

PHYSICAL SAFETY
LINEAR MODEL

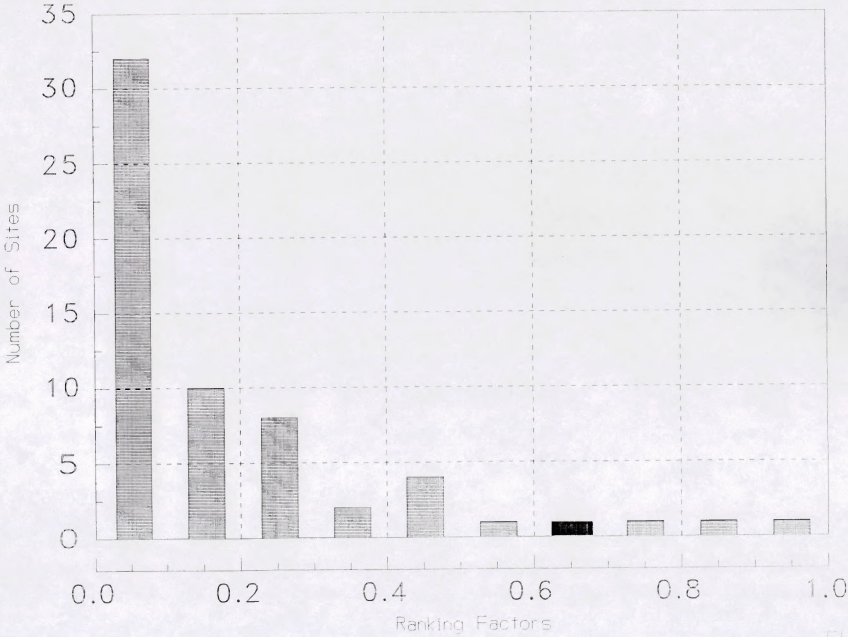

Figure 1

PHYSICAL SAFETY
LINEAR CUBE ROOT

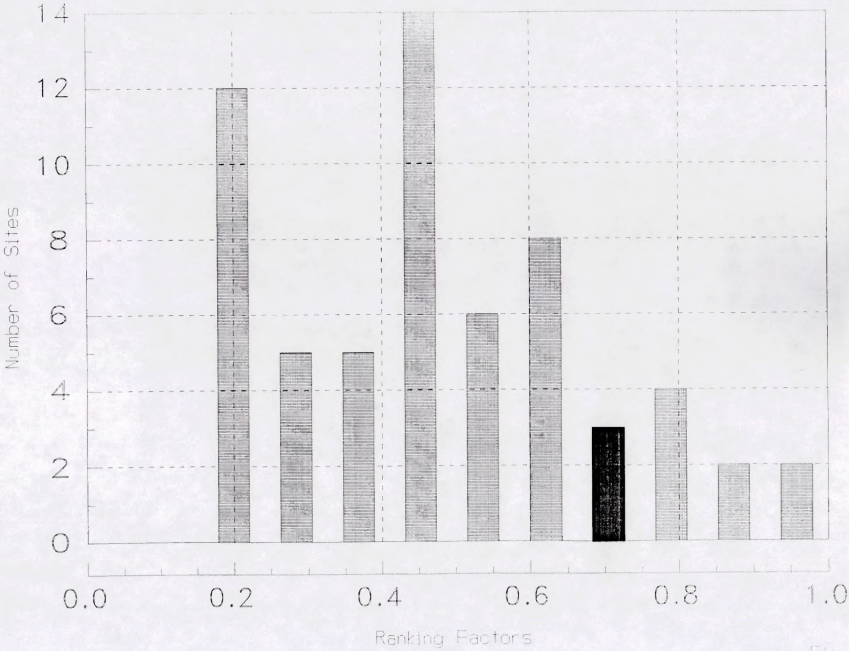

Figure 13

ENVIRONMENTAL HAZARDS

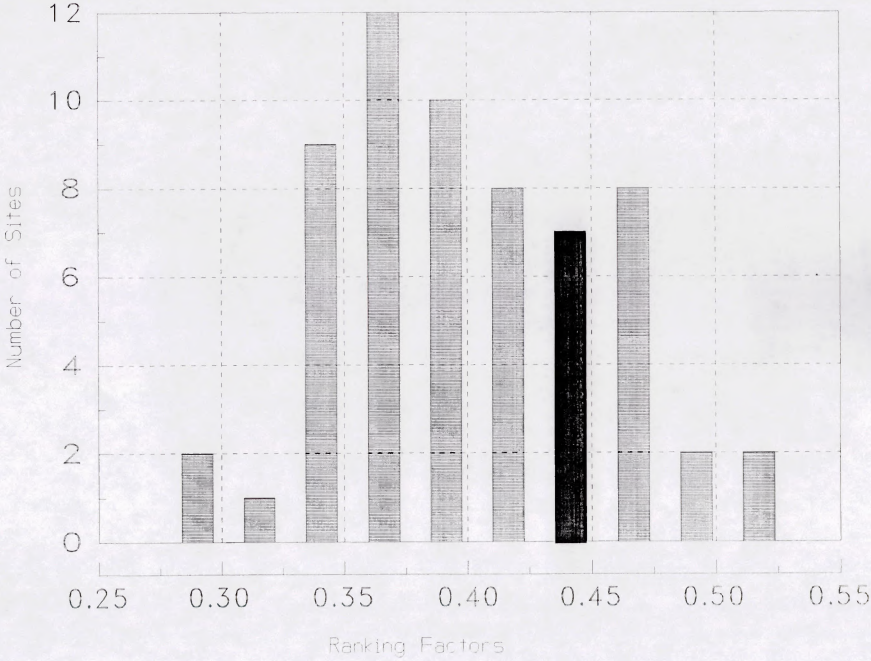

Figure 11

Reclamation ranking was given various weights for the different situations, and the cumulative points were then normalized between 0 and 1. The histogram of the solution is shown in Figure 15. The ranking program is written in dBase and therefore should be able to be re-hosted easily to be compatible with Informix (e.g., rewritten in "C" for the target system).

We are in the process of ranking Nevada's pilot project data files in order to verify that the ranking program does work with a larger volume of data.

VIII. Conclusions

A. Summary of Results for Sites Identified Through Remote Sensing in the Cottonwood Mining District

The Cottonwood mining district area covered five USGS 7.5-minute, 1:24,000, quadrangles. The quads were: Black Mesa Butte (quad #1), Blanding South (quad #2), Blanding North (quad #3), Hotel Rock (quad #4), and Mancos Jim Butte (quad #5). The following table summarizes the results of the field-gathered data:

Table 1

	Quad 1	Quad 2	Quad 3	Quad 4	Quad 5	Total
Sites remotely sensed:mining-related surface disturbance	66	0	0	0	1	67
Sites identified in the field	22	0	0	1	2	25
Sites remotely sensed:active mining operation or nonmining-related surface disturbance	119	5	1	25	7	157

Some of the discrepancy between the number of sites remotely sensed and the sites found on the ground could be that some of the features, within what we defined as the site, were counted individually in the remotely sensed data. The majority of remotely sensed sites that were not AML sites were rock outcrop or barren areas.

RECLAMATION RANKING

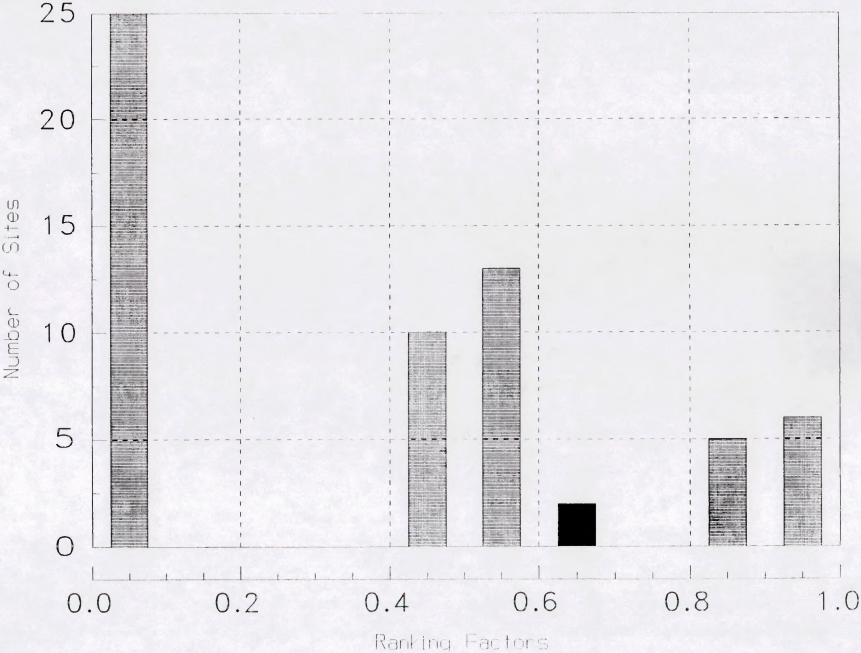

Figure 15

Using photo identification in future, we will have to develop criteria to decrease the number of non-mining features identified for field inspection in order to make it cost effective.

1. Videography

Airborne videography may be an effective tool in the future for use in identification and inventory of hazardous materials and abandoned mine sites. However, at this point in time, it is not cost effective due to the intense post-processing involved.

2. Aerial Photography

Aerial photography was effective in the identification of mine sites; however, additional criteria must be developed to make mine site identification more accurate. The scale of the photography was more than adequate for this project (1:31,680). Aerial photographs were useful in the field to find access roads into site that did not appear on the topographic maps.

It is recommended that aerial photography interpretation proceed on an experimental basis to determine whether criteria can be established to identify mine sites more accurately. For this continued testing of the role of remote sensing, we recommend that the photo scales range from 1:15,000 to 1:40,000, depending upon the degree of vegetative cover and availability of existing photography. Stereoscopic use of the aerial photos proved critical in the site interpretation/identification phase, as many of the sites were identified based on their position in relation to the general flow of the natural topography.

Additional aerial photography in Utah that can be accessed for future interpretation is the 1994-95, 1:24,000 scale, natural color aerial photography of all the wilderness study areas (WSA) and House Representatives 1500 proposed wilderness areas.

3. Additional Work Required to Fully Assess Remote Sensing

A future scheduled phase of the project will commence with the acquisition of ground spectrometry data and its subsequent correlation with multispectral videography, SPOT and Landsat TM satellite imagery, and scanned aerial photography.

A ground-based spectrometer will be used to gather information in the field at the mine sites inventoried during the 1996 field season. The University of Utah Department of Geography and Center for Remote Sensing and Cartography (CRSC) will offer assistance by using a SWIFR (ShortWave InFraRed) hand-held spectrometer. The SWIFR is similar to Landsat bands 5 and 7. The SWIFR generates its own light

source, therefore is advantageous because it does not require specific natural lighting situations. The University of Utah may also obtain a spectrometer that operates in the visible/near-infrared region of the spectrum.

The purpose of this technique is to gather specific spectral data. The spectrometer will serve to identify any unique signatures associated with the existing mine commodities (such as uranium). These signatures will be related back to the Landsat and multispectral video in a "multi-tiered" approach to provide input for a supervised classification of the imagery. If a correlation does indeed exist, it is hoped the spectral data can be used for other areas to locate these same commodities and serve as a filter in locating/classifying sites throughout the State.

In order to make future remote sensing analysis more efficient, it is recommended that the geologic data for the area be scanned as a vector file and overlain on the imagery. Specific mineral-producing formations could be identified and extracted as "highest potential" site areas. These areas would then be interpreted through remote sensing methods. Geologic areas that are not likely candidates for mining-related activities would be filtered out of the analysis procedure, thereby increasing the efficiency of the interpretation process.

B. Sites Identified Through UMOS and MILS

UMOS (MRDS) identified 27 sites whereas MILS identified 40 sites. Within the pilot project area, 61 sites were identified on the ground. These 61 sites represent 103 adits, 4 shafts, 10 open pits, 158 waste dumps, 96 prospect, etc. (Figure 16). These data bases are good for identifying some sites to be inspected on the ground, but they do not contain all the sites nor needed information to rank a site.

C. GPS

GPS was an effective tool for collecting georeferenced coordinates and recording site attributes. The field protocol outlined above, in the field identification section, was successfully used. The methodology for data dictionary construction and its use satisfied AML data requirements. The GPS will be used for the State AML inventory effort.

D. Data Base Issues

The AML pilot strategy using ArcCAD is not recommended for individual State's inventories. ArcCAD, working in the AutoCAD environment, was chosen for the Utah pilot project as a cost-effective, intermediary alternative to Arc/Info. Pilot project personnel have demonstrated that the PC-based processing strategy using ArcCAD, while conceivable, is neither the most convenient nor the most cost-effective strategy

ABANDONED MINE INVENTORY HAZARD SUMMARY

PHYSICAL SAFETY HAZARDS

ADITS 103 SHAFTS 4 OPEN PITS 10 QUARRIES 0 PROSPECT 96 SUBSIDENCE 5 WASTE PILES 158 IMPOUNDMENTS 2

CABLE & WIRE 0 CAVED WORKINGS 33 ROTTEN TIMBER 9 MINE RAIL 0 HIGHWALLS 26

UNSTABLE ROCKS 12 POOLS OF WATER 9 MACHINERY 0 EXPLOSIVES 1 MILLS 1 SLAG 0 SCRAP METAL 12

CONCRETE FOUNDATIONS 14 LAND FILL 1 ORE STOCKPILES 7 TRANSFORMERS 0 PETROCHEMICAL PRODUCTS 6 ASBESTOS 0

CHEMICALS 0 DRUMS CONTAINING MATERIAL 0 DUST 0 STORAGE TANKS 2 POWERLINES 0 TRESTLES/TRAMWAYS 2

HEADFRAMES 1 POWER STATIONS 0 AVIATION HAZARDS 0 OPEN DRILL HOLES 166

NUMBER OF STRUCTURES 10

ENVIRONMENTAL HAZARDS

0 CHEMICAL PILES OR SPILLS

0 BARRELS/TANKS/CONTAINERS

1 EXPLOSIVES (BOXES)

0 LEACH SITES/PROCESSING AREA

0 MINING EQUIPMENT

0 EVIDENCE OF UNDERGROUND STORAGE TANKS

49 DEBRIS (TIMBERS, METAL, ETC)

0 HOMESITES

77 HOUSEHOLD/AUTOMOTIVE GARBAGE

159 TAILINGS AND/OR WASTE PILES

0 ACID ODOR

TAILINGS

PRESENT 0

Figure 16

for generating a theme of AML data. The required computer skills, training issues, the difficulty in accessing base data and resource data themes in MOSS format on mainframe platforms, and software and hardware limitations make PC-based ArcCAD strategy unacceptable.

Field-collected GPS data should be differentially corrected and then exported into an appropriate format. It is recommend that data be maintained in comma-delimited ASCII files to ease the transport to various platforms and software. The Utah pilot has requested additional funding for the purchase of ArcView 2.1. (a PC/workstation-based software) to be used in lieu of the ArcCAD software.

The interface between Pathfinder and ArcInfo is very cumbersome (see previously outlined steps in this document), and data conversion is done that leads to no direct benefits. In addition, the use of Arc/Info requires a GIS workstation which is currently unavailable to the remaining personnel working on the AML pilot.

Environmental Systems Research Institute, ESRI, the vendor for the suite of ARC software, has abandoned work in ArcCad and focused its attention to ArcView. ArcView's goal was to develop a technology that integrates desktop mapping and multi-media with traditional data-analysis tools into a product that would be easy to use while offering decision analysis through spatial representation.

ArcView supports many spacial data formats, including all of the ESRI GIS data product formats on all supplied platforms. These include Arc/Info and PC ArcInfo's basic vector feature types (e.g. points, lines, and polygons), advanced-feature types (e.g., routes, regions, images, and grids) and query access to ArcStorm Data Bases. In addition ArcView has its own nonproprietary, nontopological vector feature data stored in a "shape file." Shape files can be easily converted to and from any other vector data format, facilitating the easy exchange of cartographic information between the various platforms and software in the Bureau. This allows the use of MOSS data until the Bureau's spacial data has been converted to Arc/Info.

ArcView's relational capabilities can link any SQL DBMS, ASCII, dBase or Info file to geographic data as a source for descriptive information about map features. Currently all programming for ranking sites has been done using the dBase programming language. The use of ArcView would allow the link of this data to the spacial features without converting to a different platform and/or system. By using ArcView, all information in the AML pilot can reside on a PC while allowing the user to query and view additional information contained in BLM's Corporate GIS data base in Arc/Info residing on Unix Servers.

The list of attributes used to characterize potential hazards and priority for reclamation should be reduced to a minimum number of items. Items on the AML data sheet/checklist should be identified as in-house or field attributes. Attributes that are

identified as in-house items can be analyzed using GIS tools on existing data bases in the office. Attributes that are identified as field items would have to be collected in the field.

IX. Acknowledgements

The authors would like to acknowledge the significant contributions of all participants in this inventory effort, but especially Dick Traylor, Bill Wagner, Robin Floor, Werner Brutsch and Kelly Bobbitt. Dick believed in our inventory methodology and provided necessary funding to allow us to implement our strategy. Bill continued to support our inventory effort after Dick retired. Robin suggested using GPS equipment for this inventory effort. She allowed Minerals to use the GPS equipment assigned to her and worked around our schedule. In addition, she provided technical support throughout the summer of 1993, even on weekends. Werner's surveying expertise and field experience were invaluable to the development of our field methodology. Kelly took the time to review our field methods to determine whether we were utilizing Trimble equipment to its fullest capabilities. This assistance was provided when no in-house GPS expertise was available.

In addition, we would like to extend our appreciation to Diane Saint-Thomas, Alan Rabinoff and Dave Snyder for editing this report.

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Appendix 1

ABANDONED MINED LANDS FIELD INVENTORY DATA SHEET

Geographic State ___ District/Resource Area Office _____ Site ID _____

BOM MAS No. _____ MDS No. _____ Inspected by _____ Date _____

A. Location Data
Site/Mine Name: _____
County: _____ Watershed Name: _____
USGS Quadrangle: _____
UTM Coordinates: _____N_____ E Datum: 27 _ 83 _
Township, Range, Section, and ¼ Section: _____

B. Operation Type
Pit __ Quarry __ Underground __ Mill __ Placer __ Smelter __ Prospect __ Dredge __
Exploration Drilling __ Trenches __ Other _____
Operator (last known): _____ Production Period: Begining _____ Ending _____ years.
Locatable: ___ Last Known Plan of Operations or Notice No.: _____
Salable: ___ Contract or Permit No.: _____
Leasable: ___ Case ID No.: _____
Commodity: _____
Operation Status: Abandoned __ Inactive ___ Active ___ Unknown ___
Land Ownership: Private ___ BLM ___ State ___ Municipal __ County ___ USFS __ NPS ___Other _____
_____

C. Site Description
Slope: _____ Aspect: _____ Elevation: _____

D. Resources:

Threatened or Endangered Species: Amphibians ___ Bats ___ Birds ___ Rodents ___ Mammals ___ Plants __ N/A ___
Visibility of the site easily seen ___, seen when pointed out or sought ___, hidden ___ N/A ___
From what distance is the site easily visible? _____
Site is in or within a mile of the following types of areas: ACEC ___ WSA ___ Wilderness Area ___ Riparian ___ Nominated for designation or designated to the National Wild & Scenic Rivers System _____

Rescue Information: _____

E. Physical/Safety

Adits __ Shafts __ Open Pits __ Quarries __ Prospect __ Subsidence __ Waste Piles __ Impoundments ___
Cable & Wire __ Caved Workings __ Rotten Timber __ Mine Rail __ Highwalls __ (Highwall length __ width ___)
Unstable Rock __Pools of Water __ Machinery __ Explosives __ Mills __ Slag __ Scrap Metal __
Concrete Foundations __ Landfill __ Ore Stockpiles __ Transformer __ Petrochemical Products __ Asbestos __
Chemicals __ Drums Containing Material __ Dust __ Storage Tanks __ Powerlines __ Trestles/tramways __
Headframe __ Power Substations __ Aviation Hazards (Overhead Cables and/or Wires) __ Open drill holes __ Other ___
_____

Number of Structures: ___ Type: _____ Condition: Good ___ Fair __ Poor ___
Not applicable ___
Potential Historic Structures in Area? ___
Physical/Safety Rating: ___

F. Environmental/HAZMAT Hazards

Hazardous Materials:

Site is under regulatory action_____ CERCLIS Number _____

Potential Human Targets

Nearest potable drinking water (surface and underground): _____Distance: ___ miles
Nearest named water source: _____ Distance: ___ miles
Nearest trail/campground: _____ Distance: ___ miles
Nearest dwelling: _____ Distance: ___ miles

Nearest school: _____ Distance: ___ miles
Nearest workplace: _____ Distance: ___ miles
Nearest road: _____ Distance: ___ miles

Resources Potentially Impacted:

Nearest sensitive environment name: _____ Location: _____
Potentially affects BLM resources within 1 mile: ___
Potentially affects nonpublic domain resources: ___

Environmental Hazards:

__ Chemical Piles or Spills
__ Barrels/Tanks/Containers
__ Explosives (Boxes)
__ Leach Sites/Processing Area
__ Mining Equipment
__ Evidence of Underground Storage Tanks
__ Debris (Timbers, metal, etc.)
__ Homesites
__ Household/Automotive Garbage
__ Tailings and/or Waste Piles
__ Acid Odor

Geology:

Sulfide minerals present? Yes __ No __ Unknown __

Tailings:

Present: ___ Cumulative Acres: _____
Configuration: Confined ___ Unconfined ___ Unknown ___
Particle Size of Tailings: Sand ___ Silt/Clay ___ Both ___
Surface Features: Hardpan ___ Surface Crust ___ Color Change First Inch ___ Salts __ Color _____

Radiation: For Uranium mining areas. (Depict on this form the highest value taken at the site. The sketch map should identify all readings taken at the site.)

Tailing: Scintillometer reading _____ CPS
Waste dump: Scintillometer reading _____ CPS
Ore stock pile: Scintillometer reading _____ CPS
Shaft: Scintillometer reading _____ CPS
Adit: Scintillometer reading _____ CPS
Prospect: Scintillometer reading _____ CPS

Water:

Inventory all areas associated with the mine, such as access roads, waste rock piles, refuse piles, etc. Please depict all features on a sketch map with pH and conductivity readings associated with the given feature noted. On the questions below note the worst reading taken on the mine site with corresponding map number given to that location. Warning - do not touch or taste water.

Water is flowing out of mine workings (adits, shafts, pits, etc.). ___ pH ___ Conductivity ____ GPM ___
Map Number ___
Water is standing in mine workings (adits, shafts, pits, etc.). ___ pH ___ Conductivity ____ Map Number ___
Water is flowing through or over the tailings/waste rock/stock piled ore (if it exists.) ___ pH ___ Conductivity ___
Map Number ___
Water bed color: Brown __ Orange __ Green __ Grey-black __ Yellow __ Yellow/Orange __ Other _____
There is evidence of aquatic life in the drainages near the site. (If yes enter 1, if no enter 0) ___
Estimate the distance to the nearest named drainage: _____ (ft.) flowing into: _____
Above mine site pH: _____ Conductivity: _____
Below mine site pH: _____ Conductivity: _____
Adjacent water sources (seep,spring) within .25 mile: ___ pH: _____
Staining of Soils: ___
Hazmat/Environmental Rating: ___

Does this site require immediate follow-up investigation? ___
Who should investigate? Law Enforcement ___ BLM ___ Other _____
N/A ____

Reclamation:

Erosion/sedimentation: ___
Characterize the vegetation: Healthy ___ Struggling/Stressed ___ Dead ___ Nonexistent ___
Vegetation Density: Sparse ___ Moderate ___ Dense ___
Site naturally revegetated? ___
Floodplain Intersection: Currently within ___ 1 yr. ___ 10 yr. ___ 100 yr. ___ 500 yr. ___ N/A ___
Trash on site which should be picked up? ___
Reclamation Rating: ___

G. Access Road & Perimeter:
Upon departure collect GPS data for the access road and the perimeter of the mine site.

Level of difficulty of access: 2 wd ___ 4 wd ___ Hike ___ Helicopter ___
Access road length by width (feet): _____
Describe Access route: _____
_____

Total size of surface disturbance length by width (feet): _____ Acres _____

H. On an attached piece of paper, draw a **SKETCH MAP** of the site. Show map orientation, approximate scale, access route, drainages in the vicinity, adits, shafts, and the location of each of these features.

I. Attach **LABELED PHOTOGRAPHS** and negatives or slides of the site, including photographs of hazards, resource impacts, access routes, and anything else that might be useful. **PHOTOGRAPHS HELP TREMENDOUSLY IN EVALUATING MANAGEMENT OPTIONS.**

Photo station number: _____ Location: _____ Roll No.: _____ Photo No.: _____
Aerial Photo No.: _____
May have multiple entries.

Potential mitigation/closure/reclamation methods:
1. If you were to design a reclamation plan for this site, what would you do? Check the appropriate boxes and describe below if necessary:

___ Cable nets (bolted over entrances), grates
___ Bulkheads (e.g., rock and mortar or formed concrete installed in entrances.)
___ Polyurethane foam (PUF) (expands 30X when installed; earthen backfill at surface)
___ Gates
___ Explosives (blast openings closed)
___ Backfill shafts, pits, entrances.
___ Fences
___ Cleaning up
___ Install warning signs
___ Recontour
___ Topsoil or other soil amendments
___ Revegetate, either by seeding or transplanting
___ Stabilize deteriorating structures
___ Destroy deteriorating structures
___ No action - The site is naturally reclaiming and poses no resource impacts or safety hazards.
___ No closure required
___ Water treatment
___ Drainage control
___ Use nonmechanized equipment to close site
___ Plug open drill holes
___ Other _____

Describe details _____
_____
_____

2. Mitigation status: none ___, temporary measures - fence ___, sign ___, other ___; hazards adequately mitigated (y/n) ___.
Condition: good ___ fair ___ poor ___
Tag number: _____ Locations of tags: _____ Reclamation Complete: _____
Comments: _____

K. Closure Information
To be completed upon reclamation of the site.
Date reclamation completed: _____
Type of closure: _____
Cost: _____
Comments: _____
Frequency of compliance inspection to ensure closure is intack and working properly: _____
Date of compliance inspection(s): _____

Appendix 2

SHOWDDF Version 1.7 (SSF Ver 311)
File name: amlsite5.ddf
AMLSITE5 ID = 748110789 Database version = 0

AML_SITE Uc1 = Uc2 = POINT Feature
Comment:

GEO_STATE Uc1 = Uc2 =
Comment:
Format: char string
char str length = 2 characters long
Editable = Yes
Nulls allowable = Yes

DIST_RA Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

SITE_ID Uc1 = Uc2 =
Comment:
Format: number
max value = 9999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 7
Editable = Yes
Nulls allowable = Yes

BOM_MAS_NO Uc1 = Uc2 =
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Format: number
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min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 10
Editable = Yes
Nulls allowable = Yes

UGS_MDS_NO Uc1 = Uc2 =
Comment:
Format: char string
char str length = 10 characters long
Editable = Yes
Nulls allowable = Yes

INSPECTOR Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DATE Uc1 = Uc2 =
Comment:
Format: date
Automatic generation = ON
date format = MM/DD/YY
Editable = Yes
Nulls allowable = Yes

MINE_NAME Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

COUNTY_ID Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0

units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

WATERSHED Uc1 = Uc2 =
Comment:
Format: char string
char str length = 12 characters long
Editable = Yes
Nulls allowable = Yes

USGS_QUAD Uc1 = Uc2 =
Comment:
Format: char string
char str length = 25 characters long
Editable = Yes
Nulls allowable = Yes

PIT Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

QUARRY Uc1 = Uc2 =
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Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

UNDERGRND Uc1 = Uc2 =

Comment:

Format: number

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min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

MILL Uc1 = Uc2 =

Comment:

Format: number

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default value = 0.000000
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Nulls allowable = Yes

PLACER Uc1 = Uc2 =

Comment:

Format: number

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default value = 0.000000
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Nulls allowable = Yes

SMELTER Uc1 = Uc2 =

Comment:

Format: number

max value = 1.000000
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Nulls allowable = Yes

PROSPECT Uc1 = Uc2 =
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units = Not implemented
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Nulls allowable = Yes

DREDGE Uc1 = Uc2 =
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default value = 0.000000
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units = Not implemented
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Nulls allowable = Yes

EXPLOR Uc1 = Uc2 =
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Nulls allowable = Yes

TRENCH Uc1 = Uc2 =
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Format: number
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Nulls allowable = Yes

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default value = 0.000000
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Editable = Yes
Nulls allowable = Yes

OPERATOR Uc1 = Uc2 =
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Nulls allowable = Yes

PROD_PER Uc1 = Uc2 =
Comment:
Format: char string
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Editable = Yes
Nulls allowable = Yes

LOCATABLE Uc1 = Uc2 =
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default value = 0.000000
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units = Not implemented
output length = 1
Editable = Yes

Nulls allowable = Yes

PLAN_NOT_NO Uc1 = Uc2 =
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Nulls allowable = Yes

SALABLE Uc1 = Uc2 =
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Format: number
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default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

CONT_PER_NO Uc1 = Uc2 =
Comment:
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

LEASABLE Uc1 = Uc2 =
Comment:
Format: number
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min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

CASE_ID_NO Uc1 = Uc2 =
Comment:
Format: char string
char str length = 30 characters long

Editable = Yes
Nulls allowable = Yes

COMMODITY Uc1 = Uc2 =
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Format: number
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default value = 0.000000
decimal places = 0
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Editable = Yes
Nulls allowable = Yes

STATUS Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
ABANDONED Uc1 = Uc2 =
Comment:
INACTIVE Uc1 = Uc2 =
Comment:
ACTIVE Uc1 = Uc2 =
Comment:
UNKNOWN Uc1 = Uc2 = ** default menu value
Comment:

PRIV_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

BLM_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
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output length = 1
Editable = Yes
Nulls allowable = Yes

STATE_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
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default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

MUNIC_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

COUNT_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 1
Editable = Yes
Nulls allowable = Yes

USFS_LAND Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
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Editable = Yes
Nulls allowable = Yes

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Nulls allowable = Yes

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Editable = Yes
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SLOPE Uc1 = Uc2 =
Comment:
Format: char string
char str length = 8 characters long
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ASPECT Uc1 = Uc2 =
Comment:
Format: char string
char str length = 14 characters long
Editable = Yes
Nulls allowable = Yes

T_E_AMPHIB Uc1 = Uc2 =
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Nulls allowable = Yes

T_E_BATS Uc1 = Uc2 =
Comment:
Format: number
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default value = 0.000000
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units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

T_E_BIRDS Uc1 = Uc2 =
Comment:
Format: number
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min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

T_E_RODENTS Uc1 = Uc2 =
Comment:
Format: number
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min value = 0.000000
default value = 0.000000
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units = Not implemented
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Editable = Yes
Nulls allowable = Yes

T_E_MAMMAL Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

T_E_PLANTS Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

NO_T_E Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 1
Editable = Yes
Nulls allowable = Yes

VISIBILITY Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
EASILY SEEN Uc1 = Uc2 =
Comment:
SEEN IF SOUGHT Uc1 = Uc2 =
Comment:
HIDDEN Uc1 = Uc2 =
Comment:
N/A Uc1 = Uc2 = ** default menu value
Comment:

VISIB_DIST Uc1 = Uc2 =
Comment:
Format: number
max value = 100.000000
min value = 0.000000
default value = 0.000000
decimal places = 1
units = Not implemented
output length = 4
Editable = Yes
Nulls allowable = Yes

ACEC Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

WSA Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

WILDERNESS Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

RIPARIAN Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

NWSRS Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 1
Editable = Yes
Nulls allowable = Yes

ADITS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

SHAFTS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

OPEN_PITS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

QUARRIES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

TRENCHES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

PROSPECTS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

SUBSIDENCE Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

WASTE_PILES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

IMPNDMENTS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

CABLE_WIRES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

CAVED_WRKS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 3
Editable = Yes
Nulls allowable = Yes

ROTTEN_TIMBERS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

MINE_RAILS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

HIGHWALLS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

LENGTH_FT Uc1 = Uc2 =
Comment:
Format: number
max value = 9999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 4
Editable = Yes
Nulls allowable = Yes

WIDTH_FT Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

UNSTABL_RX Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

H2O_POOLS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

MACHINERY Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

EXPLOSIVES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

MILLS Uc1 = Uc2 =
Comment:
Format: number
max value = 9.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

SLAG Uc1 = Uc2 =
Comment:
Format: number
max value = 99.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 2
Editable = Yes
Nulls allowable = Yes

SCRAP_METL Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

CONCRETE Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

LAND_FILL Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

ORE_PILES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

TRANSFORM Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

PETROCHEMS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

ASBESTOS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

CHEMICALS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

DRUMS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

DUST Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

STOR_TANKS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 3
Editable = Yes
Nulls allowable = Yes

POWERLINES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

TREST_TRAM Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

HEADFRAMES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

POWER_SUBS Uc1 = Uc2 =
Comment:
Format: number
max value = 99.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 2
Editable = Yes
Nulls allowable = Yes

AVIAT_HAZ Uc1 = Uc2 =
Comment:
Format: number
max value = 99.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 2
Editable = Yes
Nulls allowable = Yes

OPEN_HOLES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

OTHER_HAZ Uc1 = Uc2 =
Comment:
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

STRUCTURES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000

default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

STRUCT_TYP Uc1 = Uc2 =
Comment:
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

STRUCT_CON Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
GOOD Uc1 = Uc2 =
Comment:
FAIR Uc1 = Uc2 =
Comment:
POOR Uc1 = Uc2 =
Comment:
N/A Uc1 = Uc2 = ** default menu value
Comment:

HIST_STRUCT Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

SAFTEY_COMMENTS Uc1 = Uc2 =
Comment:
Format: char string
char str length = 100 characters long

Editable = Yes
Nulls allowable = Yes

SAFTEY_RATING Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

REGULATORY Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

CERCLIS Uc1 = Uc2 =
Comment:
Format: char string
char str length = 12 characters long
Editable = Yes
Nulls allowable = Yes

POTBLE_H2O Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes

Nulls allowable = Yes

DIST_POT_H2O Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

NAMED_H2O Uc1 = Uc2 =
Comment:
Format: char string
char str length = 25 characters long
Editable = Yes
Nulls allowable = Yes

DIST_NAMED_H2O Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

TRAIL_CAMP Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DIST_TRAIL Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

DWELLINGS Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DIST_DWELL Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

SCHOOL Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DIST_SCHOOL Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

WORK_PLACE Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DIST_WRK Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

ROAD Uc1 = Uc2 =
Comment:
Format: char string
char str length = 20 characters long
Editable = Yes
Nulls allowable = Yes

DIST_ROAD Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

SENS_ENVIR Uc1 = Uc2 =
Comment:
Format: char string
char str length = 25 characters long
Editable = Yes
Nulls allowable = Yes

SENS_ENL_LOC Uc1 = Uc2 =
Comment:
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

BLM_1_MI Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

NON_PUBLIC Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

CHEM_PILES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

BARREL_TNKS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

BOXES_EXPLOSIVES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

LEACH_SITE Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented

output length = 3
Editable = Yes
Nulls allowable = Yes

MINE_EQUIP Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

UNDRG_TANK Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

DEBRIS_ETC Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

HOMESITES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

HSHLD_AUTO_DEBRIS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

TAIL_WASTE_PILES Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

ACID_ODOR Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

SULFIDE_MINERALS Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
YES Uc1 = Uc2 =
Comment:
NO Uc1 = Uc2 =
Comment:
UNKNOWN Uc1 = Uc2 = ** default menu value
Comment:

TAILS_PRESENT Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

TAIL_ACRES Uc1 = Uc2 =
Comment:
Format: char string
char str length = 5 characters long
Editable = Yes
Nulls allowable = Yes

TAIL_CONFIG Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
CONFINED Uc1 = Uc2 =
Comment:
UNCONFINED Uc1 = Uc2 =
Comment:
UNKNOWN Uc1 = Uc2 = ** default menu value
Comment:

TAIL_PART_SIZE Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
SAND Uc1 = Uc2 =
Comment:
SILT/CLAY Uc1 = Uc2 =
Comment:
BOTH Uc1 = Uc2 =
Comment:
UNKNOWN Uc1 = Uc2 = ** default menu value
Comment:

HARDPAN_SURF Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

SURFACE_CRUST Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

COLOR_CHNG_1IN Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000

decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

SALTS Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

COLOR Uc1 = Uc2 =
Comment:
Format: char string
char str length = 15 characters long
Editable = Yes
Nulls allowable = Yes

TAILS_CPS Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

WASTE_CPS Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0

units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

ORE_CPS Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

SHAFT_CPS Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

ADIT_CPS Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

PROSP_CPS Uc1 = Uc2 =
Comment:
Format: number

max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

H2O_FLOW Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

FLOW_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

FLOW_COND Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

GPM Uc1 = Uc2 =
Comment:
Format: number
max value = 99999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 5
Editable = Yes
Nulls allowable = Yes

H2O_STANDING Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

STAND_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

STAND_COND Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

H2O_TAILS Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000

default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

TAILS_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

TAILS_COND Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

H20_BED_COLOR Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
BROWN Uc1 = Uc2 =
Comment:
ORANGE Uc1 = Uc2 =
Comment:
GREEN Uc1 = Uc2 =
Comment:
GREY_BLACK Uc1 = Uc2 =
Comment:
YELLOW Uc1 = Uc2 =
Comment:
YELLOW_ORANGE Uc1 = Uc2 =
Comment:
OTHER Uc1 = Uc2 = ** default menu value

Comment:

AQUA_LIFE Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

DIST_DRAIN_FT Uc1 = Uc2 =
Comment:
Format: number
max value = 9999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 4
Editable = Yes
Nulls allowable = Yes

FLOW_INTO Uc1 = Uc2 =
Comment:
Format: char string
char str length = 25 characters long
Editable = Yes
Nulls allowable = Yes

AB_MINE_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

AB_MINE_CONDUCT Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000

min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

BL_MINE_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes
Nulls allowable = Yes

BL_MINE_CONDUCT Uc1 = Uc2 =
Comment:
Format: number
max value = 999999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 6
Editable = Yes
Nulls allowable = Yes

AJ_H2O_25_MI Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

AJ_H2O_PH Uc1 = Uc2 =
Comment:
Format: char string
char str length = 4 characters long
Editable = Yes

Nulls allowable = Yes

STAIN_SOILS Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

HAZ_ENV_COMMENTS Uc1 = Uc2 =
Comment:
Format: char string
char str length = 100 characters long
Editable = Yes
Nulls allowable = Yes

HAZ_ENV_RATING Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

FOLLOW_UP Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

```
WHO                    Uc1 =       Uc2 =
   Comment:
   Format: menu
         Editable              = Yes
         Nulls allowable       = Yes
   LAW_ENFORCEMENT       Uc1 =       Uc2 =
    Comment:
   BLM                 Uc1 =       Uc2 =
    Comment:
   NA                  Uc1 =       Uc2 =       ** default menu value
    Comment:
   OTHER               Uc1 =       Uc2 =
    Comment:

EROS_SEDIMENT          Uc1 =       Uc2 =
   Comment:
   Format: number
         max value             = 1.000000
         min value             = 0.000000
         default value         = 0.000000
         decimal places        = 0
         units                 = Not implemented
         output length         = 1
         Editable              = Yes
         Nulls allowable       = Yes

VEG_CHARACTER          Uc1 =       Uc2 =
   Comment:
   Format: menu
         Editable              = Yes
         Nulls allowable       = Yes
   HEALTHY             Uc1 =       Uc2 =
    Comment:
   STRESSED            Uc1 =       Uc2 =
    Comment:
   DEAD                Uc1 =       Uc2 =
    Comment:
   NONEXISTANT         Uc1 =       Uc2 =       ** default menu value
    Comment:

VEG_DENSITY            Uc1 =       Uc2 =
   Comment:
   Format: menu
         Editable              = Yes
```

Nulls allowable = Yes
SPARSE Uc1 = Uc2 = ** default menu value
Comment:
MODERATE Uc1 = Uc2 =
Comment:
DENSE Uc1 = Uc2 =
Comment:

NATR_REVEG Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

FLOODPLAIN Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
CURRENT WI 1 YR Uc1 = Uc2 =
Comment:
CURRENT WI 10 YR Uc1 = Uc2 =
Comment:
CURRENT WI 100 YR Uc1 = Uc2 =
Comment:
CURRENT WI 500 YR Uc1 = Uc2 =
Comment:
N/A Uc1 = Uc2 = ** default menu value
Comment:
CURRENTLY WI Uc1 = Uc2 =
Comment:

TRASH_CLN Uc1 = Uc2 =
Comment:
Format: number
max value = 1.000000
min value = 0.000000
default value = 0.000000

decimal places = 0
units = Not implemented
output length = 1
Editable = Yes
Nulls allowable = Yes

REC_COMMENTS Uc1 = Uc2 =
Comment:
Format: char string
char str length = 100 characters long
Editable = Yes
Nulls allowable = Yes

REC_RATING Uc1 = Uc2 =
Comment:
Format: number
max value = 999.000000
min value = 0.000000
default value = 0.000000
decimal places = 0
units = Not implemented
output length = 3
Editable = Yes
Nulls allowable = Yes

End of Abandoned Mined Lands Field Inventory Data Sheet

Data Dictionary for AML Road
AML_ROAD Uc1 = Uc2 = LINE Feature
Comment:
DIFFICULTY Uc1 = Uc2 =
Comment:
Format: menu
Editable = Yes
Nulls allowable = Yes
2WD Uc1 = Uc2 =
Comment:
4WD Uc1 = Uc2 =
Comment:
HIKE Uc1 = Uc2 =
Comment:
OTHER Uc1 = Uc2 = ** default menu value
Comment:

Data Dictionary for AML Perimeter

AML_PERIMETER Uc1 = Uc2 = AREA Feature

Comment:

DESCRIP Uc1 = Uc2 =

Comment:

Format: char string

char str length = 100 characters long

Editable = Yes

Nulls allowable = Yes

SITE_ID Uc1 = Uc2 =

Comment:

Format: char string

char str length = 12 characters long

Editable = Yes

Nulls allowable = Yes

Data Dictionary for AML Point

AML_POINT Uc1 = Uc2 = POINT Feature

Comment:

DESCRIP Uc1 = Uc2 =

Comment:

Format: char string

char str length = 100 characters long

Editable = Yes

Nulls allowable = Yes

SITE_ID Uc1 = Uc2 =

Comment:

Format: char string

char str length = 12 characters long

Editable = Yes

Nulls allowable = Yes

Point (generic) Uc1 = Uc2 = POINT Feature

Comment: created on pathlog ver 2.59

COMMENT Uc1 = Uc2 =

Comment: created on pathlog ver 2.59

Format: char string

char str length = 30 characters long

Editable = Yes

Nulls allowable = Yes

Line (generic) Uc1 = Uc2 = LINE Feature
Comment: created on pathlog ver 2.59
COMMENT Uc1 = Uc2 =
Comment: created on pathlog ver 2.59
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

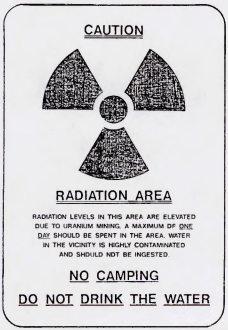
Area (generic) Uc1 = Uc2 = AREA Feature
Comment: created on pathlog ver 2.59
COMMENT Uc1 = Uc2 =
Comment: created on pathlog ver 2.59
Format: char string
char str length = 30 characters long
Editable = Yes
Nulls allowable = Yes

Appendix 3

Mining and Minerals Branch
Land Resources Division
National Park Service
Department of the Interior

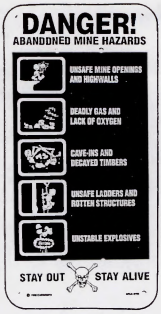
Highwall Warning Sign

size: 12"x18"
color: black on 3M reflective yellow background
material: aluminum
availability: Currently available from MMB. Signs were made by Utah Department of Corrections at a cost of $10.00 each. MMB does not have the funding to supply large numbers of these signs, and cannot supply signs for park hazards that are not associated with AML sites.
comments: Signs were designed for posting along the top edge of highwalls in abandoned pits and quarries.



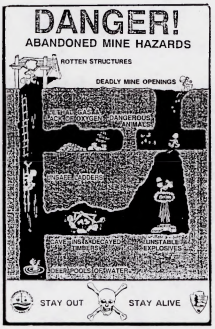
Radiation Warning Sign

size: 12"x18"
color: black text on 3M reflective yellow background, magenta radiation symbol
material: aluminum
availability: Currently available from MMB. Signs were made by Utah Department of Corrections at a cost $10.00 each. MMB does not have the funding to supply large numbers of these signs.
comments: Signs were designed for posting in or near the portals of abandoned uranium mines.



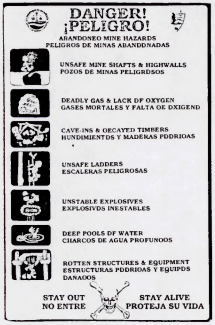
Abandoned Mine Warning Sign (Backcountry)

size: 8"x16"
color: brown on white
material: Carsonite composite fiber
availability: Currently available in small quantities from MMB sign coordinator. Signs can also be ordered directly from Carsonite 1-800-648-7974. The minimum order is 25 signs, approx price is $8.00 each. Recommend combining order through Region or MMB to get lower price with larger quantities.
comments: Sign material is rated for 20 years of exposure. Pre-drilled for mounting on posts or fence.



Abandoned Mine Warning Sign (English)

size: 11"x17"
color: black and white
material: Tyvek paper or Lexan plastic
availability: Currently available in small quantities from MMB sign coordinator. Will be stocked in NPS central supply when funding becomes available.
comments: Paper signs are for outdoor use on bulletin boards, trailhead signs, or on-site. Lexan signs are for display in visitor contact stations.



Abandoned Mine Warning Sign (Spanish)

size: 11"x17"
color: black and white
material: Tyvek paper or Lexan plastic
availability: Currently available in small quantities from MMB sign coordinator. Will be stocked in NPS central supply when funding becomes available.
comments: Paper signs are for outdoor use on bulletin boards, trailhead signs, or on-site. Lexan signs are for display in visitor contact stations.